BRITISH DESMIDS.

A SUPPLEMENT TO

BRITISH FRESH-WATER ALGÆ.

With 66 Coloured Plates.

BY

M. C. COOKE, M.A., LL.D., A.L.S.,

Author of "British Fresh-Water Algæ," "Illustrations of British Fungi," "Mycographia," "Handbook of British Fungi," "The Woodlands," "Ponds and Ditches," "Freaks and Marvels of Plant Life," "The Myxomycetes of Great Britain," &c., &c.

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INTRODUCTION.

The Desmids, to which this volume is devoted, constitute the first family of the Zygophyceæ,* or, according to some, form a distinct section of the Conjugatæ, closely allied to the Zygnemaceæ.

The configuration of the cells is multiform, from the single cylindrical and spindle-shaped, to those with most complicate but symmetrical, lobate, or dentate outlines, whilst each species retains always its characteristic form. In most cases each cell is divided into two equal and symmetrical halves by a cross constriction, which is either a shallow groove or a deep and narrow incision, so deep as to convey to some observers the impression that each cell consisted of a pair of closely united bodies of equal dimensions. These cells live separate from each other, and are free, or else are united end to end in a filament, whilst each cell retains its own individuality. They are surrounded by a cellulose membrane, which, in some cases, must contain considerable inorganic matter, since, when calcined carefully, the remains still retain their original form. As Ralfs † long ago intimated, "all the Desmidieæ are gelatinous. In some, the mucus is condensed into a distinct and well-defined hyaline sheath or covering, as in *Desmidium cylindricum* and *Staurastrum tumidum;* in others it is more attenuated, and the fact that it forms a covering is discerned only by its preventing the contact of the coloured cells. In general, its quantity is merely sufficient to hold the fronds together in a kind of filmy cloud, which is dispersed by the slightest touch. When they are left exposed by the evaporation of the water, this mucus becomes denser, and is apparently secreted in larger quantities to protect them from the effects of drought. I have observed more especially that *Tetmemorus granulatus* and *Penium Brebissonii*, under such circumstances, form a distinct mucous stratum." With the exception of *Sphærozosma* the side walls only of the cells united in rows, or chains, are surrounded by mucus, so long as they remain connected, but, when they become free, the flat ends also secrete mucus.

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* See Cooke, "Fresh Water Algæ," p. 74.

† Ralfs, "British Desmidieæ," p. 15.

A delicate primordial membrane, intimately joined to the cellulose membrane, surrounds the cell-contents. It appears in most cases to be simply a homogeneous transparent cuticle, rich in nitrogen, and generally bears a plasma stratum of a fine granular appearance, which is deposited on its inner wall. In this plasma stratum earlier observers noticed a visible movement, through the locomotion of the granules, sometimes called rotation or circulation. De Bary, whom we have followed rather closely in this "Introduction," has applied himself to the investigation of these movements, which, he says, are found to a most astonishing extent, particularly in *Closterium lunula* and *Tetmemorus granulatus*, when the cells are in very brisk vegetation and division. He says,* "The small granules of the stratum are impelled very quickly in numerous small streamlets to and fro. These glide in constant change, sometimes from the middle of the cell to the end, at other times in the reverse direction, irregularly gliding by one another, and by those granules which are at rest. At one margin of the semi-cell we find a stream going to the cell end, at the other one going from the end to the middle, so that it appears at first sight to be a rotation analogous to that of *Chara* cells, but we see by constant observation that the movement is always transposed in different directions. Where the plasma is collected in great plenty, we perceive most clearly that the currents exist throughout the whole mass, not alone either in the primordial membrane, or the stratum bounding the watery cell-contents." . . . . "We see that the observed streams are caused by one constant movement of the whole granular plasma-mass, which alternately accumulates at different points, and again retreats. Whether, therefore, the change in the direction of the streams is, in fact, as irregular as it appears at first sight to be, or whether, on the contrary, one does not follow the other in regular progress around the whole circumference of the cell, has hitherto not been decided, on account of the opacity of the chlorophyll contents." The existence of internal cilia, as maintained by Osborne, is denied, and the appearances accounted for as optical illusions.

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* De Bary, "Conjugateen."

All the Desmids are tinted green by chlorophyll, and the colouring matter is confined to bodies of regular form, such special form and structure being very often characteristic of separate genera or species. In some species the endochrome is accumulated in parietal bands, and in *Spirotænia* and *Genicularia* the elongated ribbons are arranged spirally as in *Spirogyra*. Mr. Archer was the first to point out that in *Xanthidium* the endochrome forms in each segment four parietal quarters rather than bands, these interrupted or separated by as many narrow, nearly straight vacancies running down the centre of each front, and each lateral aspect of the segment. In *Mesotænium* the simple laminated endochrome either runs directly through the longitudinal axis of the cell, or sometimes slightly concentrically, as a sharply-defined chlorophyll plate. In most species of *Staurastrum* the endochrome is arranged in plates radiating from a common centre, so that in an end view it presents a more or less perfectly stellate appearance.

The elongated middle band in the cells of *Closterium* and *Penium* generally exhibit several starch granules arranged in one long row, very exceptionally only one. In other genera the starch granules are fewer, and more irregularly disposed. In rare cases starch granules of determined shape and structure are not to be seen, but the application of iodine will usually detect the amorphous starch which permeates the chlorophyll.

The spaces which remain free between the chlorophyll and the wall plasma are filled with a watery fluid. Within this fluid are suspended in plenty a great number of incommensurably small dancing granules in lively molecular motion. Under this head come the vesicular spaces so often mentioned, as found in the ends of *Closterium*. These terminal vacuoles are often sphærical, or half oval in shape, containing either a few or a great number of dancing granules. If we isolate the separate granules while we crush a cell, they clearly show that they have the form of a very small rhomboidal tablet, with sharp corners and angles. They remain unchanged by burning, or by treatment with concentrated acids and cold alkali. At all events, they answer to inorganic bodies, and are probably small crystals of gypsum, but, on account of their excessive minuteness, the accuracy of this suggestion cannot be tested by closer analysis. Other small granules in the cell fluids of *Cosmarium botrytis* (and perhaps of other species) have a different composition, for they will dissolve readily in reagents, and are destroyed by burning, but are insoluble in alcohol.

The increase of cells in the Desmids by ordinary cell division is by no means uncommon, and may be seen illustrated on several of the plates (Pl. XXXV., f. 5, *c d*; Pl. XLVI., f. 2, *b*; Pl. XLVII., f. 4, *e*; Pl. L., f. 9, *e*). The process has been so often observed and described that it need not be repeated here. It does not differ in its chief characteristics from the similar process in other Algæ. The isthmus, or connecting tube, between the two semi-cells elongates, a hyaline lobe is formed at each retreating base, connate at the convex extremity. These lobes continue to grow in size, becoming coloured, and by degrees attain the form and dimensions of the original semi-cells; meanwhile the old segments are pushed farther and farther apart, until at length separation takes place between the two new semi-cells, and two individuals are free, each with one old semi-cell and one new semi-cell, or daughter cell, combined to form a complete individual.

As to the movements of Desmids very little can be added to what has been stated by Ralfs,* for De Bary confesses that he has nothing of importance to contribute, but that all conclusions as to their animal or vegetable nature must be considered in abeyance. Meanwhile, no one doubts of their truly vegetable nature. Braun† only confirmed Ralfs. Alluding to *Penium curtum* he says, "The plant here named is remarkable for exhibiting the peculiar movement of the Desmidiaceæ more regularly, and more actively, than the other members of the family, a motion very different from that of the Diatomaceæ. It is a remarkable sight to behold all the individuals in a dish of water in a short time turn their long axes to the light, and thus arrange themselves in beautiful streaks in the gelatinous mass. Observation with the microscope shows that it is the younger half of the cell which here turns towards the light."

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* Ralfs, "Desmidieæ," p. 20.

† Braun, "Rejuvenescence," p. 203, *note*.

With this exception hardly any attention has been paid to the influence of light on the movements of Desmids. Stahl recently made some experiments in this direction,* chiefly with *Closterium moniliferum*, which he enclosed in glass tubes, changing the direction of the light by means of mirrors. It soon became evident that the direction of the light exercised a material influence on the position of the longer axis of the cell, this axis having a tendency to place itself in the direction of the rays of light, and that there is also a polarity between the two halves of the cell, in consequence of which one is attracted towards, and the other driven away from the source of light. The direction is subject to alternations, in consequence of which the cell is continually shifting its position through an angle of 180°, presenting each end alternately to the light. In one experiment, at a temperature of 33° C., the time occupied by this reversal of position was from six to eight minutes; in another, where the temperature [illegible] thirty-five minutes. In addition to this reversal there [illegible] a slow movement of the individual along the bottom in the direction of the source of light. When the light is very intense the conditions are reversed, and the cell places itself with its longer axis at right angles to the direction of the light. Dr. Göbel has made similar experiments on *Micrasterias rotata*, which was found to place itself with the plane of its disk at right angles to the direction of the rays of light. The direction of the chlorophyll band varies with that of the incident light.†

The conjugation of Desmids and formation of the zygospore is very similar in all species. The cells lie surrounded by loose and indistinctly circumscribed mucus in pairs together, always crossed in *Staurastrum*, and parallel in *Closterium*. In *Closterium lunula* the concave sides are turned towards each other; in other species parallel or crossing each other in different ways. Out of the contiguous sides each cell projects a short cylindrical "copulation process," rounded at the ends. Each advances towards the other until they meet and coalesce. In some species the process emerges in the first instance from a gaping fissure in the original cell wall; in others there is no cracking of the cell or cross fissure of the membrane. The "copulation processes" are in all cases surrounded by a tender membrane; at the free end the membrane is thicker. The contents of the "process" consist of a colourless plasma of watery fluidity, in which separate granules are suspended.

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* "Verh., Physikal Med. Gesell. Wurzburg," xiv. (1880), p. 24.

† "Journal of Royal Micros. Society," iii. (1880), pp. 318.

Both "copulation processes" swell, apparently at the same time, into wide bladders, of which one quickly attains a semicircular form, touching the other inwardly with a flat surface. The parting wall which separates them is immediately dissipated. The primordial membranes are melted into one, and a continually swelling middle space is formed, uniting the two cells. At this time the primordial membrane has been loosened from the cell membrane of the four half-cells, and gradually retreats towards the middle. At the first, only protoplasm and colourless fluid pass over from the old cells into the middle space, then follow the cell-kernels from both sides; and, lastly, the chlorophyll, with the last ends of the primordial utricle. In the cases observed by De Bary there elapsed 15, 20 to 40 minutes from the first swelling of the processes until the complete absorption of the primordial membrane from the four half-cells.

From this point forward there are slight variations, in different species, in the development of the zygospore from the swollen central space lying between the old semi-cells. In *Cosmarium botrytis* the middle space is, during its swelling, surrounded by a tolerably thick, but uncommonly tender, membrane, having the appearance of a homogeneous gelatinous wall. Inside the mucous bladder, which is continually becoming paler, the primordial membrane contracts itself to a regular globular form. Already, after 10-15 minutes, it possesses a visibly tender, almost completely smooth, cellulose skin. After about two hours the first intimations of the later spikes of the zygospore are visible as small projections of the cell wall. The successive formation of the three skins which clothe the ripe zygospore then follow.

The difference between the forms of copulation consists in this, that the middle space in *Closterium parvulum* is surrounded by a permanent cellulose skin; in the others by a mucous membrane, which often becomes invisible. Most of the conditions described by Ralfs range themselves between these two forms, or are transitions towards them.

The structure of the mature zygospore corresponds in the Desmidieæ with that of *Zygnema*, &c. There exist three cuticles in succession from the outside to the inside; the outer cuticle of cellulose; the middle cuticle, generally, though not always, tinged, and often very dark-brown; and a colourless inner cuticle exhibiting the reaction of cellular tissue.

The ripe zygospores of *Cosmarium*, *Euastrum*, and allied species are known to have on their outer surface prickles and projections of various shapes. In extreme youth the surface is smooth. Soon we see numerous projections thrown up, until the prominences assume the characteristic form and size of the mature prickles of the species. Their membrane thickens itself, while it deposits new cellulose sheaths from the outward end towards the inside. The spines, therefore, soon become solid bodies. In the contents of the ripe zygospore has been found chlorophyll and starch, the latter partly replaced by fat.

Observation of the process of germination, or the development of new individuals from the zygospore, seems to be rare. Wolle summarizes the result of De Bary's observations thus—"The envelope of the matrix or zygospore is primarily thin and smooth, but by degrees it acquires increased thickness, and in the Cosmariums usually a granular, tuberculated, or, more frequently, a spinous surface, the spines being sometimes simple, but commonly forked at the extremities. The next step, so difficult to be traced, is the opening of the wall of the zygospore, setting free small spheres of sarcode. As they issue they enlarge, and acquire a gelatinous or thin membranous wall. The wall thickens, and the sphere enlarges, the contents constrict first in one direction, and then transversely to the plane of the first incision. These parts develop and set free two or four new plants, in size and form like the mother cell, except in the cytioderm or membrane; this is not granular, but smooth, and so remains until after the multiplication by division takes place. After the first division the new semi-cells assume the characteristic granular surface; the result of this first division is two plants, each composed of one granulated and one smooth semi-cell. The second division will make two perfect cells, and two which retain the one smooth semi-cell. The third division produces eight cells, all of which, except the original two semi-cells, will be of typical form."

Although it has been stated in vague general terms that zoospores are produced in the Desmids, the only foundation for the assertion appears to have been the presence of these bodies in genera now excluded from the Desmidiaceæ. An examination of all these general affirmations precedes the announcement by Mr. W. Archer of his discovery of undoubted zoospores in one species of *Docidium*.* Although up to the present time we have no knowledge of the confirmation of the observations then described, there is not the slightest ground for doubting their accuracy.

In order that these observations may be accurately stated, it may be as well to quote them in the words of our author. It may be premised that the *Docidium* in question was *Docidium Ehrenbergii*. "These bodies," writes Mr. Archer, "although I am quite ignorant of their after-development, I cannot but believe to be zoospores; and I imagine I am justified in the conclusion; their appearance and mode of formation seem to be so comparable to the zoospores in Cladophora, where they undoubtedly, as is well known in this, as in various other Algæ, propagate the plant and form young colonies in abundance. The first indication of the commencement of the phenomenon is the production of a single minute hyaline lateral tubercle, or sometimes of two, or, more rarely still, of three such tubercles, just under the inflation at the base of, I imagine, the younger segment. This tubercle arises—and the same holds when there are two or

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* "On Zoospores in the Desmidiaceæ," by W. Archer. "Natural History Review," July, 1860; "Quarterly Journ. Micro. Science," Vol. viii. (1860), pp. 215.

three—not from any part of the original segments, but from a special extension of the boundary wall interposed between the inflated base of the segment and the sutural line. In other words, the tubercle is not produced between the segments by their separation at the suture, but from an extension, or addition, at the base to one only of the segments. When the segment gives rise to one tubercle only, this additional growth is gradually developed more and more narrowly, diminishing to nothing at the opposite point of the cylindrical segment, so that the frond is thus thrown out of the straight, or nearly straight direction, and becomes bent into a knee-shape. Such is also the case when two projections arise side by side. But when two originate opposite to each other, or when there are three, the frond is not thrown out of its straight form, because the new addition to the segment, from which these lateral growths take their origin, now forms an annular extension equal all round, and the segment, therefore, becomes added to in length by just so much as the annular addition is broad—and this is less than ·00033 inch (·0083 mm.)—but of very varied degrees of length. I have noticed some to cease to grow after having barely attained about one-tenth, or one-eighth part of the length of the frond, and I have seen a few very long, almost, if not quite as long, as the frond itself. The endochrome near the base of each segment, and in the neighbourhood of the lateral tube, next becomes very finely granular, of an almost homogeneous appearance, and the lateral tube is filled by it. The remainder of the endochrome is still but little altered from the ordinary condition, and the terminal cavities with the active granules remain unchanged. The annular addition and the lateral tubes are quite smooth, and destitute of the scattered puncta which characterize the empty frond in this species."

I have before stated that the endochrome near the base of each segment, and filling the lateral tubes, becomes very finely granular; it next becomes segmented into a definite number of rounded portions, or "gonidia." I was never able to count them exactly, but I suppose they were not less than twenty, nor over fifty; nor did the fact of there being either two or three lateral tubes developed seem to indicate any very great addition to the number of these bodies. That portion of the endochrome not thus transformed into gonidia lying beyond them, and extending to the ends of the segments, by this time loses its normal character, and seems to become drawn into detached bands or strings, with a few free granules, and the terminal cavity, with the active particles, becomes lost. The gonidia lately formed at the middle of the frond have now emerged through the opened apex of the lateral tube, and remain clustered together in a mass very much like a bunch of grapes, the clusters becoming by degrees larger and larger, until all the gonidia make their exit through the tube, and each adds its quota to the group. The same is the case when there are two or three tubes, the only difference being that a fewer number, but generally about equal, make their way through each. Meantime the unused endochrome, which had become drawn into detached strings, now loses its bright-green colour, changing somewhat to an olive, finally turning brown, and quite dying, and even, to a great extent, disappears. Each of the gonidia forming the external cluster appears by this time to have formed for itself a special cell wall of slightly compressed or elliptic form, within which the green contents may often be seen somewhat retracted. Now a movement within its circumscribed prison may be seen on the part of the contents of a few of the gonidia, which takes the appearance of a twisting motion, backwards and forwards, as it were, on its axis, similar to what may be sometimes seen in the organisms called Trachelomonas, by Ehrenberg. I have not noticed them to turn completely round. These gonidia are, however, greatly smaller, nor could I perceive any red spot. If such a comparison might not appear wholly out of place, I would be induced to say that the movement of the green contents within the confining membrane reminded me somewhat of the movement of the eye in certain Entomostraca. This movement is not apparent in all the whole group of gonidia simultaneously, but only in a few at a time. Eventually, one by one, the green contents leave the confining membrane in which they have hitherto been detained, but I am unable to say in what manner they made their exit. There certainly appeared no necklike opening or perceptible aperture, but they probably escaped by rupturing the boundary wall. Having, however, made their escape, they swim away as ovate or pyriform ciliated bodies, pale at the narrower or pointed end, and green otherwise throughout—in point of fact, veritable motile gonidia or zoospores, in every way comparable to the similar bodies found in other algæ their principal distinction from those, for instance, in *Cladophora* being their temporarily abiding in a cluster, each encysted in its special coating. I vainly tried to satisfy myself whether these zoospores were *one* or *two*-ciliated, but I was not able to decide this difficult point. They were about ·00027 inch (·0068 mm.) in their narrower diameter, and somewhat greater longitudinally.

Having one by one escaped, the vacated cells remain not long attached at the apex of the lateral tube, and I think they fall away therefrom sometimes in a more or less connected condition and finally decay. The old frond now generally separates at the suture, one segment bearing away the empty special structure described, the other, of course, unchanged; any remaining endochrome by this time being quite brown, broken up and dead, if indeed it be not altogether vanished. I imagine it might be possible that in the native pool the whole endochrome might be used up in the production of the zoospores. The empty cell membranes or old segments were to be found for some time afterwards in the gathering when all traces of the zoospores had completely disappeared, and I may add that the formation of zoospores occupied only two days, when there was a complete cessation of their development. The gathering was made in the month of September."

Little remains to be said of the habitats, collection, and preservation of these minute organisms. Being, for the greater part, free swimming plants, they need not be sought in swift streams, but rather in pools, ponds, little depressions in swampy land, amongst *Sphagnum* in bogs, and in a few instances on rocks subject to the continual drip of water. It must be remembered that they are confined to fresh and clear water, the rarest and most interesting being found at a considerable elevation in mountainous districts. Microscopists are now so efficient in modes and appliances for collecting that it is unnecessary to attempt details beyond suggesting that *shallow* and not deep waters must be sought. Mounting for preservation is not in so satisfactory a condition. All kinds of media have been suggested, but, after all, the water in which the specimens are found has been proved the most suitable, since it does not disturb the endochrome, which any fluid of greater density would do. If it is considered desirable to preserve the green colour the slides should not be exposed to the light more than is absolutely necessary. Another method of preserving specimens for future study is to dry them on small squares of paper or thin mica. These can be moistened at any time, and the specimens examined, but unfortunately in a deteriorated condition, for the endochrome will disappear and the cells collapse. The free use of the pencil and camera-lucida in making drawings to an uniform scale from the fresh specimens is, after all, the very best course.

No excuse need be offered for the production of the present work, since its want has been felt for many years. We can only hope that it may answer all reasonable expectations.

M. C. C.

May, 1887.

BRITISH DESMIDS.

ORDER I. *ZYGOPHYCEÆ.*

Either cellular or multicellular algæ, with terminal vegetation, and destitute of true ramification. Cells single, segregate, or geminate, or united in a series. Chlorophyll-mass for the most part distributed in plates, or bands, including one or more amylaceous granules.

Multiplication by division of the cells in one direction.

Propagation by zygospores, resulting from the conjugation of two cells. (See " British Fresh Water Algæ," p. 74.)

FAMILY I. DESMIDIEÆ.

Unicellular algæ. Cells for the most part compressed, single, segregate, or geminate, or a larger number united in a band, or filament; variable in form, usually constricted in the middle, so as to constitute two symmetrical semi-cells.

Minute unicellular algæ, inhabiting fresh water. Cells consisting of two symmetrical equal portions, their junction marked by a pale interruption of the endochrome, and frequently by a constriction, devoid of silex; increasing by the formation of two new half-cells, interposed between the two halves of the older cell. Cells either becoming free or united into a filament. Endochrome green. Reproduction by conjugation of the contents of two distinct cells, which result in the production of zygospores, the contents of which afterwards become differentiated into young cells of a new generation. Ciliated zoospores (in one species only) produced by conversion of the endochrome.

Sect. A. LEIOSPORÆ.

Sect. B. COSMOSPORÆ.

Sect. A. LEIOSPORÆ. Zygospores normally smooth.

Sub-sect. *a.* *Individuals more or less closely united in threads or filaments.*

GENUS 1. **GONATOZYGON.** *De Bary* (1856).

Filament cylindrical; joints elongated, slender, cylindrical, or narrow-fusiform, without a constriction or inflation; ends truncate; endochrome a single central, longitudinal, undulatory, contracted band. Joints, previous to conjugation, disunited, and during the process bent into a knee-shape. Zygospore placed between the empty conjugated joints.—*Archer in Pritch. Infus.* p. 721.

Gonatozygon Ralfsii. *De Bary Conj.* 76, *t.* 4, *f.* 23-25.

Joints cylindrical, with the ends somewhat dilated, ten to twenty times as long as broad, rough on the surface with numerous minute scattered granules; endochrome sometimes bifid at the extremities, usually with a pale space at the centre, and with a longitudinal series of lighter-coloured dense corpuscles down the middle. Zygospore orbicular, smooth, placed between the conjugating joints, which are bent in an angular manner.

SIZE. Diam. 11-12 μ* (W.); 10½-19 μ (K.); 10 μ (R.).

Archer in Pritchard's Infusoria (1861), p. 722, t. 3, f. 1, 2. Cleve Sver. Desm. (1864), p. 496. Lundell Desm. Suec. (1871), p. 96. Kirchner Alg. Schles. (1878), p. 131.

Docidium asperum, Ralfs. Desm. (1848), p. 158, t. 26, f. 6.

Leptocystinema asperum, Archer Micr. Journ. (1859), p. 134.

Gonatozygon asperum, Rabh. Krypt. Fl. Sachs. (1863), p. 181. Rabh. Alg. Eur. (1868), p. 155. Wolle Desm. U.S. (1884), 22, t. 1, f. 1.

HAB. In pools.

Penzance, France, Germany, Sweden, United States.

Plate I., fig. 1. *a*, living cells; *b*, empty cells; *c*, zygospore.

Gonatozygon Brebissonii. *De Bary Conj.* 77, *t.* 4, *f.* 26, 27.

Joints ten to sixteen times as long as broad, narrow-fusiform, somewhat capitate at the ends, loosely united, often single, rough on the surface, with minute scattered granules; endochrome usually with a pale space at the centre, and a series of corpuscles down the middle. Zygospore orbicular, smooth, placed between the conjugating joints, which are angularly bent.

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* Throughout this work the measurements are given in millimètres (mm.) or micro-millimètres (μ). The figures are magnified, unless otherwise stated, about 400 diam.

SIZE. Diam. 5 μ (C.) ; 7 μ (A.).

Archer in Pritch. Inf. (1861), p. 722. Lundell Desm. Suec. (1871), p. 96. Wittrock Scan. Desm. (1869), p. 24. Rabh. Alg. Eur. (1868), p. 156. Nordstedt Desm. Spits. (1872), p. 26.

Docidium asperum, Brebisson in Ralfs. Desm. (1848), t. 26, fig. *d.*, p. 159. Breb. Liste (1856), p. 147.

Leptocystinema Portii, Archer Micr. Journ. (1859), p. 134.

Gonatozygon asperum, Cleve Sver. Desm. (1864), p. 496. Nordstedt Norges Desm. (1873), p. 50.

HAB. In pools.

Ireland, France, Germany, Sweden, Norway, Spitsbergen.

Plate I., fig. 2. *a*, living cells; *b*, empty cell; *c*, zygospore.

Gonatozygon Kinahani. *(Archer.) Rabh. Alg. Eur.* III., 156.

Filament two to three inches long, often breaking up into separate joints ; joints twenty to forty times as long as broad, linear, smooth. Endochrome in its broader diameter filling the entire width, in the narrower not more than one-third, occupying the centre of the joint, and at the central pale space curved towards the cell wall, and having embedded within it a longitudinal median series of globose, light-coloured, dense corpuscles, retracted at each end of the joint, leaving a clear space containing active granules. Zygospore unknown.

SIZE. Diam. 12-13 μ (A.).

Leptocystinema Kinahani, Archer Nat. Hist. Rev., Vol. v., p. 250. Pritch. Inf. (1861), p. 722, t. iii., f. 4.

HAB. Ireland.

Plate I., fig. 3. *a*, living cells; *b*, single cells.

GENUS 2. SPHÆROZOSMA. *Corda* (1835).

Filament compressed ; joints deeply divided on each side, thus forming two segments, and giving a pinnatifid appearance to the filament, united to each other by a narrow isthmus, or by glandular processes. Sometimes enclosed in a mucous sheath. Zygospores globose or oval, smooth.

* *Gelatinous sheath evident.*

Sphærozosma vertebratum. *Ralfs. Desm.* 65, *t.* 6, *f.* 1 ; *t.* 32, *f.* 2.

Joints as long as broad, constriction deep, acute ; segments reniform, gland-like processes oblique, solitary at the end of each margin. Gelatinous sheath evident. Zygospore spherical, smooth, placed between the empty segments, the filament previous to conjugation breaking up into single joints.

SIZE. Diam. 12-14 μ (W.); 22-33 μ (K.); 25-35 μ (R.). Zygospore 21 μ.

Rabh. Alg. Eur. (1868), iii., 148. De Bary Conj. t. 4, f. 32-34. Brebisson Liste Desm. (1856), p. 119. Archer in Prit. Inf. (1861), p. 24, t. 1, f. 15-17. Cleve Sver. Desm. (1864), p. 496. Lundell Desm. Suec. (1871), p. 91. Petit Liste Desm. Paris (1877), p. 29. Wolle Desm. U.S. (1884), t. 4, f. 13. Wittrock Scan. Desm. (1869), p. 25. Jacobsen Desm. Denm. (1874), p. 211. Kirchner Alg. Schles. (1878), p. 133.

Odontella ? unidentata, Ehr. Infus. (1838), p. 159.

Isthmia vertebrata, Meneg. Syn. Desm. (1840), p. 205.

Isthmosira vertebrata, Kutz. Phy. Germ. (1845), p. 141.

Sphærozosma unidentatum, Ralfs. Ann. N. H. (1845), xvi., t. 3, f. 7.

Sphærozosma elegans, Corda Alm. Carls. (1835), t. 4, f. 37. Hassall Fr. Alg. p. 348, t. 84, f. 1.

HAB. In ditches.

Cornwall, Sussex, Kent, Westmoreland, Norfolk; France, Germany, Italy, Sweden, Denmark, United States.

Plate II., fig. 1. *a*, living cells; *b*, empty cells; *c*, side view; *d*, transverse view; *e f*, zygospores.

Sphærozosma excavatum. *Ralfs. Desm.* 67, *t.* 6, *f.* 2.

Joints longer than broad, subquadrate, very minute, constriction a deep rounded sinus on both sides, and two sessile gland-like projections on each margin at their junction; angles sometimes with three very minute teeth; no evident gelatinous sheath. Zygospore elliptic, placed between the empty joints, the filament previously breaking up.

SIZE. Diam. 9-12 μ (W.); 8-12 μ (K.); 10 × 13 μ (R.).

Rabh. Alg. Eur. (1868), iii., 29. Wolle Desm. U.S. (1884), t. 4, f. 8-12. Brebisson Liste Desm. (1856), p. 119. Archer in Prit. Inf. (1861), p. 724. Nordstedt Desm. Arct. (1875), p. 15. Cleve Sver. Desm. (1864), p. 469. Lundell Desm. Suec. (1871), p. 92. Nordstedt Norges Desm. (1873), p. 47. Petit Liste Desm. Paris (1877), p. 29. Wood F. Water Algæ U.S. (1872), p. 123. Wittrock Scan. Desm. (1869), p. 25. Notaris Desm. Ital. (1867), p. 29, t. 1, f. 5. Wille Nor. Sem. (1879), p. 62. Nordstedt Desm. Spitz. (1872), p. 26. Jacobsen Desm. Denm. (1874), p. 211. Kirchner Alg. Schles. (1878), p. 133.

Isthmosira excavata, Kutz. Phyc. Germ. (1845), p. 141.

Schistochilum excavatum, Ralfs. Flor. Tunbr. Wells (1845), p. 192.

HAB. In pools.

Cornwall, Sussex, Kent, Surrey, Hants, Westmoreland, Lancashire, Gloucester; France, Spitzbergen, Germany, Denmark, Norway, Sweden, Nova Zembla, United States.

Plate II., fig. 2. *a*, living cells; *b*, transverse view; *c*, empty cells; *d*, empty cells further magnified; *e*, zygospore.

Sphærozosma filiforme. *(Ehr.) Rabh. Alg. Eur.* III., 149.

Joints about as long as broad; constriction acute; segments elliptic, and united by double slender processes, which include a quadrate foramen between each pair.

SIZE. Diam. 12-18 μ (W.); 12-14 μ (K.).

Wolle Desm. U.S. (1884), t. 4, f. 5, 6. Archer in Prit. Inf. (1861), p. 724. Archer Micr. Journ. (1869), p. 197. Lundell Desm. Suec. (1871), p. 91. Jacobsen Desm. Denm. (1874), p. 212. Kirchner Alg. Schles. (1878), p. 133.

Tessarthra filiformis, Ehr. Inf. 154, t. 10, f. 21.

Isthmosira filiformis, Kutz. Phyc. Germ. (1845), p. 141.

HAB. In pools.

Ireland, Germany, Sweden.

Plate II., fig. 6. *a*, living cells; *b c*, empty cells.

Sphærozosma pygmæum. *Rabh. Alg. Eur.* III., 150.

Filament minute, joints a little broader than long, even, acutely notched, segments about twice as broad as long, almost elliptical, constriction a linear, acute notch; end view subelliptic. Enclosed in a narrow hyaline sheath.

SIZE. 8 × 8 μ (C.).

Cooke in Grevillea ix., 39.

HAB. In pools. Barmouth, N. Wales.

Plate II., fig. 5. *a b*, living cells; *c*, empty cells; *d*, empty cells × 1000.

** *Filaments destitute of a mucous sheath, isthmus obsolete.*

Sphærozosma secedens. *De Bary Conj.* 67, *t*, 4, *f.* 35-37.

Filament very fragile; joints as long as broad; constriction a shallow rounded sinus; segments subelliptic, ends concave; no gelatinous sheath.

SIZE. 12 × 10 μ (C.).

Rabh. Alg. Eur. (1868), iii., 150. Archer Micr. Journ. (1871), p. 92.

Spondylosium secedens, Archer in Prit. Inf. (1861), p. 724.

Hab. In ditches.

Ireland, Germany.

Plate II., fig. 3. *a*, living cells; *b c*, empty cells × 800; *d*, transverse view.

Sphærozosma pulchellum. (*Archer.*) *Rabh. Alg. Eur.* III, 150.

Filament minute, fragile; joints about as broad as long, sharply incised; segments laterally inflated at the base, thus giving a pouting appearance to the joint, narrowing to the ends, which are straight, with square angles; endochrome containing in each segment a single central lighter-coloured globose corpuscle. No evident gelatinous sheath.

Size. 9-10 μ broad, 10-13½ μ long (K.); 9-11 μ (C.).

Spondylosium bambusioides, Wittrock Scan. Desm. (1869), p. 25, fig. 12.

Spondylosium pulchellum, Archer Prit. Inf. (1861), p. 724, t. 3, f. 10. Quart. Journ. Micr. Sci. xvii. (1877), p. 191. Lundell Desm. Suec. (1871), p. 92. Nordstedt Norges Desm. (1873), p. 49. Jacobsen Desm. Denm. (1874), p. 212. Kirchner Alg. Schles. (1878), p. 134.

Hab. In pools.

Ireland, Germany, Sweden, Norway, Denmark.

Plate II., fig. 4. *a*, living cells; *b*, empty cells × 600.

Genus. 3. **ONYCHONEMA.** *Wallich* (1860).

Filament compressed. Margins inciso-serrate. Joints deeply constricted, and united to each other by diverging sub-capitate processes (cornua).

The remarkable form of [illegible] horns (cornua) and the uncinate processes [illegible] the segments, at once distinguish this genus from all others.—*Ann. Nat. Hist. Ser.* iii., *Vol.* v., *p.* 195.

Onychonema Nordstedtiana. *Turner Journ. Roy. Micr. Soc.* 1865, 934, *t.* 15, *f.* 3.

Cells forming filaments of fifty or sixty cells or more, connected by the curious sub-capitate claspers peculiar to this genus. Without these processes the cells resemble smooth *Cosmaria*, as they do not posses the hooklets (at the ends of the segments) which pertain to *O. uncinatum*, W., and *O. læve*, Nord. Chlorophyll confluent.

Size. 14 μ long × 18 μ broad. Gelatinous sheath, 36-40 μ broad. Isthmus, 3-4 μ.

Strensall Common, near York.

Plate II., fig. 7. *a*, living cells; *b c*, empty cells (after Turner); *d*, empty cell × 500.

GENUS. 4. **HYALOTHECA.** *Ehr.* (1840).

Filament cylindrical, very gelatinous; joints having either a slight constriction, which produces a crenate appearance, or a grooved rim at one or both ends, which forms a bifid projection at each side; end view circular; endochrome radiate. Zygospores round, smooth.—*Archer in Pritch. Inf.* p. 722.

Hyalotheca dissiliens. *(Smith.) Ralfs. Desm.* 52, *t.* 1, *f.* 1.

Filament fragile, crenate; joints usually broader than long, with a shallow groove round each, dividing the endochrome into two portions. Zygospore globose, smooth, placed between the persistent connecting tube formed by the mutual fusion of a fresh extension from and produced between the sides opposed to each other of the conjugating pairs of joints, the filament having previously broken up into single joints.

SIZE. Diam. 20-36 μ (W.); 22-34 μ (K.); 14-25 μ (R.). Zygospore 25 μ.

Rabh. Alg. Eur. (1868), iii., 152. Wolle. Desm. U.S. (1884), t. 1, f. 3. Breb. in litt. (1846) fide Ralfs. Breb. Liste Desm. (1856), p. 118. Ralfs. Brit. Algæ No. 22. Archer Pritch. Inf. (1861), p. 722, t. 2, f. 32 and 35. Delponte Desm. (1876), p. 69, t. 1, f. 1-12. Nordstedt Desm. Arct. (1875), p. 16. Cleve Sver. Desm. (1864), p. 496. Lundell Desm. Suec. (1871), p. 94. Nordstedt Norges Desm. (1873), p. 48. Petit Liste Desm. Par. (1877), p. 29. Grunow Desm. Austr. (1858), p. 498. Nordstedt and Wittr. Desm. Ital. (1876), p. 27. Wood F. Water Algæ U.S. (1872), p. 124. Wittrock Scan. Desm. (1869), p. 26. Notaris Desm. Ital. (1867), p. 25, t. 1, f. 1. Wille Nov. Sem. (1879), p. 61. Jacobsen Desm. Denm. (1874), p. 212. Kirchner Alg. Schles. (1878), p. 131.

Conferva dissiliens, Smith Engl. Bot. (1812), t. 2464.

Gleoprium dissiliens, Berk. Ann. N. H. (1845), xvi., p. 11. Hassall Fr. Alg. (1845), p. 346, t. 83, f. 3.

Desmidium mucosum, Breb. Alg. Fal. (1835), p. 65, t. 2.

Hyalotheca mucosa, Kutz. Phyc. Germ. (1845), p. 140. Kutz. Sp. Alg. (1849), p. 187.

HAB. In ponds and shallow waters.

Generally distributed through England and Wales (J. R.), Ireland (W. A.), Scotland (G. D.). France, Germany, Austria, Norway, Italy, Spitzbergen, Sweden, Denmark, Nova Zembla, United States.

var. **major.** Delponte Desm. (1876), t. 1, f. 1, 3, 4, 7, 10, 11, 12.

SIZE. 36 × 27 μ (D.).

Plate III., fig. 1. *a,* living cells; *b,* empty cells; *c,* transverse view; *d,* zygospore.

var. **minor.** Delponte Desm. t. (1876), 1, f. 2, 5, 6, 8, 9.

SIZE. 21 × 18 μ (D.).

Plate III., fig. 1. *e,* living cells.

Hyalotheca mucosa. *(Mert.) Ralfs. Desm.* 53, *t.* 1, *f.* 2.

Filament scarcely fragile, mucous sheath very broad; joints about as broad as long, not constricted, but having at one of the ends a minute bidentate projection on each margin, the adjoining end of the next joint being similar, these projections being produced by an annular grooved rim.

SIZE. Diam. 19-21 μ (W.); 18-20 μ (K.); 21 μ (D.); 20-22 μ (R.).

Rabh. Alg. Eur. (1868), iii., 152. Wolle Desm. U.S., (1884), t. 1, f. 13. Ehr. Kurze. Nach. (1840). Breb. Liste Desm. (1856), p. 118. Archer in Pritch. Inf. (1861), 722. Ralfs. Brit. Algæ No. 23. Lundell Desm. Suec. (1871), p. 94. Nordst. Desm. Bras. p. 296. Nordstedt Norges Desm. (1873), p. 48. Petit Liste Desm. Paris (1877), p. 29. Wood F. Water Algæ U.S. (1872), p. 124. Wittrock Scan. Desm. (1869), p. 26. Notaris Desm. Ital. (1867), p. 26, t. 1, f. 2. Kirchner Alg. Schles. (1878), p. 131.

Conferva mucosa, Mert. Dillw. Conf. (1809), t. B. Harv. Man. 127.

Gleoprium mucosum, Hass. Fr. Alg., p. 346, t. 83, f. 5. Ralfs. Ann. N. Hist. (1845), xvi., t. 3, f. 6.

Hyalotheca Ralfsii, Kutz. Sp. Alg. (1849), 187.

Mesotænium armillare, Delponte Desm. (1876), p. 62, t. 1, f. 13-19.

HAB. In shallow pools, and gentle streams.

Herts, Essex, Sussex, Devon, Kent, Wales, Scotland; France, Norway, Germany, Italy, Sweden, Brazil, United States.

Plate III., fig. 2. *a,* living cells; *b,* transverse view; *c d,* empty cells; *e f,* empty cells further magnified.

GENUS. 5. BAMBUSINA. *Kutz.* (1845).

Cells or joints barrel-shaped, surrounded by one or two narrow median bands, closely united into nodose jointed filaments. Chlorophyll mass in end view 6-10 radiate. Zygospores round, smooth.

Bambusina Brebissonii. *Kutz. Phyc. Germ.* 140.

Joints inflated, barrel shaped, longer than broad, without a thickened border at their junction, angles bicrenate, crenatures rounded, transverse view circular. Zygospore elliptic, formed within the persistent extensions from the conjugating joints, which do not previously break up into single joints, but couple, still united in the filament in a confused or zigzag manner, some of the joints remaining unchanged.

SIZE. Diam. 22 μ (R.) ; 18-25 μ (W.) ; 28 × 36 μ (D.).

Lundell Desm. Suec. (1871), 95. Rabh. Alg. Eur. (1868), iii., 153. De Bary Conj. 76, t. 4, f. 28, 29. Wolle. Desm. U.S. (1884), t. i., f. 15-24.

Bambusina Brebissonii, Kutz. Nordstedt Norges Desm. (1873), p. 49. Petit Liste Desm. Paris (1877), p. 29. Wood F. Water Algæ U.S. (1872), p. 125. Breb. Liste Desm. (1856), p. 119. Rabh. Alg. Eur. (1868), iii., p. 153. Kirchner Alg. Schles. (1878), p. 132.

Gymnozyga bambusina, Jacobsen Desm. Denm. (1874), p. 213.

Bambusina Borreri, Delponte Desm. (1876), p. 66, t. 2, f. 1-7. Wittrock Scan. Desm. (1869), p. 24. Cleve Sveriges Desm. (1864), p. 496.

Desmidium Borreri, Ralfs. Ann. N. Hist. (1843) xi., t. 8, f. 4. Hassall Fr. Alg., p. 343, t. 83, f. 9.

Didymoprium Borreri, Ralfs. Desm. (1848), p. 59, t. 3. Archer Prit. Inf. (1861), p. 723, t. 2, f. 38, 39. Ralfs. Brit. Algæ Exs. No. 25.

HAB. In quiet waters.

Hants, Sussex, Norfolk, Westmoreland, Lancashire, Wales, Scotland, Ireland; France, Germany, Italy, Sweden, Denmark, Norway, United States.

Plate IV., fig. 1. *a b,* living cells; *c d,* empty cells (*d* after DeBary); *e,* transverse view; *f g,* zygospores.

GENUS 6. **DESMIDIUM.** *Agardh.* (1824.)

Filaments 3-4 angular or compressed, regularly twisted, joints bidentate or bicrenate at the angles or lateral margins, and either closely united throughout the whole of their end margins by a thickened border, or only at the outer portion of each by mutual projections, and thus producing intervening central oval foramina.—*Archer in Pritch. Infus.* 723.

Desmidium cylindricum. *Grev. Sc. Crypt. Fl., t.* 293.

Sheath distinct; joints broader than long, with a thickened border at their junction; angles bidentate; teeth angular, transverse view broadly elliptic. Zygospore orbicular formed within one of the two conjugating joints, the endochrome passing over from one by a narrow connecting tube produced between the otherwise but little altered broken-up single joints.

SIZE. 60-80 μ broad (K.); 25 × 46 μ (D.); 37 × 40 μ (R.).

Kirchner Alg. Schles. (1878), p. 132. Wolle. Desm. U.S. (1884), t. iii., f. 1-4. Jacobsen Desm. Denm. (1874), p. 214. Lundell Desm. Suec. (1871), p. 95. Wittrock Scan. Desm. (1869), p. 24. Nordstedt Norges Desm. (1873), p. 49. Hass. Fr. Alg. (1845), p. 342, t. 83, f. 1. Cleve Sver. Desm. (1864), p. 496.

Arthodesmus ? cylindricus, Ehr. Inf. (1838), p. 1838.

Hyalotheca cylindrica, Ehr. Kurze. Nach. (1840).

Desmidium compressum, Corda Alm. Carls. (1840), p. 18.

Didymoprium cylindricum, Ralfs. Ann. N. Hist. (1845), xvi., p. 10.

Didymoprium Grevillei, Kutz. Phyc. Gen. (1843), p. 166. Ralfs. Desm. (1848), p. 57, t. 2. Ralfs. Brit. Algæ No. 24. Archer Prit. Inf. (1861), 723. Delponte Desm. (1876), p. 64, t. i., f. 20-28. Petit Liste Desm. Paris (1877), p. 30. Wood F. Water Algæ U.S. (1872), p. 125. Breb. Liste Desm. (1856), p. 118. Notaris Desm. Ital. (1867), p. 27, t. i., f. 3. Rabh. Alg. Eur. (1868), iii., p. 153.

HAB. In ponds.

Sussex, Surrey, Hants, Lancashire, Cornwall, Wales, Scotland; France, Germany, Italy, Sweden, Norway, Denmark, United States.

Plate IV., fig 2. *a b*, living cells; *c*, empty cells; *d*, transverse view; *e*, zygospore.

Desmidium Swartzii. (*Ag.*) *Ralfs. Desm., t.* 4.

Filament triangular, equal, with a single longitudinal dark waved line formed by the third angle; joints in front view somewhat quadrangular, broader than long, with two slightly angular crenatures on each lateral margin, united at the whole of their end margins by a thickened border, end view trangular, endochrome three-rayed. Zygospore oval.

SIZE. Diam. 37 μ (R.); 36 μ (W.); 24-27 μ (K.); 21-36 × 25-50 μ (D.).

Wolle. Desm. U.S., (1884), t. ii., f. 1-6. Agardh. Syst. (1824), p. 9. Ralfs. Desm. (1848), p. 61, t. 4. Ralfs. Brit. Algæ No. 26. Archer in Prit. Inf. (1861), p. 723. Harv. Man., 196., Grev. S. Cr. Fl. t. 292. Ehr. Inf., p. 140, t. 10, f. 8. Hass. Fr. Alg. (1845), p. 344, t. 83, f. 7. Delponte Desm. (1876), p. 68, t. 2, f. 8-20. Cleve Sver. Desm. (1864), p. 496. Lundell Desm. Suec. (1871), p. 95. Nordstedt Norges Desm. (1873), p. 49. Petit Liste Desm. Paris (1877), p. 30. Grunow Desm. Austr. (1858), p. 498. Wood F. Water

Algæ U.S. (1872), p. 126. Wittrock Scan. Desm. (1869), p. 25. Brebisson Liste Desm. (1856), p. 119. Notaris Desm. Ital. (1869), p. 28, t. i., f. 4. Rabh. Alg. Eur. (1868), p. 154. Jacobsen Desm. Denm. (1874), p. 214. Kirchner Alg. Schles. (1878), p. 132.

Diatoma Swartzii, Agardh. Disp. Alg. (1811).

HAB. In shallow pools.

Generally distributed in England, Wales, Scotland, Ireland; France, Germany, Sweden, Denmark, Norway, Austria, Italy, United States.

Plate V., fig. 2. *a*, living cells; *b*, empty cells; *c*, zygospores; *d*, transverse view.

Desmidium quadrangulatum. *Ralfs. Desm., t.* 5.

Filament quadrangular, varying in breadth from its twisting, having two longitudinal waved lines; joints in front view broader than long, with two somewhat rounded crenatures on each lateral margin, united by the whole of their end margins, end view quadrangular; endochrome four-rayed.

SIZE. Diam. 50-60 μ (W.) ; 24 x 57 μ (D.) ; 55 μ (R.).

Wolle. Desm. U.S., t. ii., f. 13, 14. Rabh. Alg. Eur. (1868), iii., 155. Ralfs. Ann. Nat. Hist. (1845), xv., t. 12, f. 9. Archer Prit. Inf. (1861), 723, t. 2, f. 37-40. Ralfs. Desm. (1848), p. 62, t. 5. Ralfs. Brit. Alg. No. 27. Delponte Desm. (1876), p. 72, t. 2, f. 21-27. Wood F. Water Algæ U.S. (1872), p. 126. Brebisson Liste Desm. (1856), p. 301.

Desmidium quadrangulare, Kutz. Phy. Germ. (1855), p. 141.

HAB. In boggy pools.

Cornwall, Westmoreland, Wales, Scotland; France, Germany, Italy, United States.

Plate V., fig. 3. *a*, living cells; *b*, empty cells; *c*, transverse views.

Desmidium aptogonium. *Breb. Alg. Fal.* 65, *t.* 2.

Joints quadrangular in front view, broader than long, with two rounded crenatures on each lateral margin, united at the outer portion only of each end margin by mutual projections, thus producing intervening central oval foramina.

SIZE. Diam. 25-38 μ (W.) ; 22-37 μ (K.).

Breb. Alg. Fal. p. 65, f. 2 (1835). Wolle Desm. U.S. (1884), t. ii., f. 6, 7, t. xlix., f. 7. Archer Prit. Inf. (1861), p. 723, t. 3, f. 7, 8. Cleve Sver. Desm. (1864), p. 496. Lundell Desm. Suec. (1871), 95. Nordstedt Norges Desm. (1873), p. 50. Petit Liste Desm. Paris (1877), p. 30. Wood F. Water Algæ U.S. (1872), p. 126. Wittrock Scan. Desm. (1869), p. 25. Rabh. Alg. Eur. (1868), p. 154. Jacobsen Desm. Denm. (1874), p. 214. Kirchner Alg. Schles. (1878), p. 132.

Aptogonum desmidium, Ralfs. Desm. (1848), p. 64, t. 32, f. 1. Delponte Desm. (1876), p. 73, t. 3, f. 1-5. Breb. Liste Desm. (1856), p. 119.

var. *α*. Filament triangular, regularly twisted; crenatures rounded.

Size. 18 × 28 μ (D.); 17-25 μ (R.).

Aptogonum desmidium, var. *α*. Ralfs. Desm. p. 64.

Desmidium aptogonum, var. *β*. Archer in Prit. Inf. (1861), p. 723.

Westmoreland, Wales; Italy, Sweden.

Plate V., fig. 1. *a*, living cells; *b*, empty cells; *c*, transverse view.

var. *β*. Filament plane, crenatures shallower and slightly angular.

Desmidium aptogonum, *β*. Ehrenbergii Rabh. Fl. Alg. (1868), p. 154. Lundell Desm. Suec. (1871), p. 95.

Odontella desmidium, Ehr. Inf. (1838), t. 16, f. 4.

Aptogonum desmidium, var *β*. Ralfs. Desm. p. 64, t. 32, f. 1.

Desmidium aptogonum, var *β*. Archer in Prit. Inf. (1861), p. 723.

Aptogonum diagonum, Delponte Desm. (1876), t. 2, f. 6-10.

Westmoreland; France, Germany, Italy, United States.

Size. 32 × 18 μ (D.); 19-27 μ (R.).

Plate V., fig. 1. *d*, living cells; *e*, empty cells; *f*, side view.

Sub.-sect. *b*. *Cells free, not united in a filament.*

Genus 7. **DOCIDIUM.** *Breb.* (1846).

Frond very elongated, straight, constricted at the middle; segments with an inflation at the base (rarely not so), often with others above, or with whorls of knot-like projections; ends abruptly truncate. Endochrome with a terminal rounded clear space at each end, in which are active granules.—*Archer in Pritch. Inf.* 744.

Docidium nodosum. *Bailey Micr. Obs., f.* 4.

Frond stout, suture forming a rim; segments three or four times as long as broad, with four prominent inflated nodes, including the basal, which is somewhat the largest, and which are due to so many whorls of knot-like prominences or large tubercles; ends entire, end view crenate.

Size. 0·3-0·395 mm. × 48-54 μ; apex 30-39 μ; diam. 45-55 μ in centre (W.).

Wolle Desm. U.S. (1884), p. 50, t. 11, f. 11, 12; t. 12, f. 20.

Docidium nodosum, Bailey, var. *Hibernicum*, Archer Quart. Micr. Journ. xii. (1872), p. 193. Rabh. Alg. Eur. (1868), p. 145. Ralfs. Desm. (1848), p. 218, t. 35, f. 8.

Pleurotænium nodosum, Lundell Desm. Suec. (1871), p. 90. Wood F. Water Algæ U.S. (1872), p. 120.

Closterium nodosum, Bailey in Amer. Journ. (1846), i., p. 127, f. 3.

HAB. In ponds.

Ireland, Sweden, United States.

Plate VII., fig. 2. *a*, living cell; *b*, empty cell.

Docidium coronatum. *Breb. in Ralfs. Desm.* (1848), *t.* 36, *f.* 6.

Frond stout, suture forming a thickened projecting rim; segments four to six times as long as broad, tapering, regularly inflated upwards from the base, so as to produce an undulated margin, the basal inflation the most prominent, the others less so, and wanting towards the ends; ends bordered by prominent tubercles, projecting all round; end view circular, bordered by the tubercles; empty frond coarsely punctate.

SIZE. Diam. 22-56 μ (W.); 540 × 30-58 μ (K.).

Archer in Prit. Inf. (1861), p. 745. Archer in Micr. Journ. (1874), xiv, p. 214. Brebisson Liste Desm. (1856), p. 147. Wolle Desm. U.S. (1884), 49, t. 11. f. 9, 10.

Pleurotænium coronatum, Rabh. Alg. Eur. (1868), p. 143. Kirch. Alg. Schles. (1878), p. 144.

Ireland, France, United States.

Plate VI., fig. 1. *a*, living cell; *b*, empty cell; *c*, transverse view.

Docidium nobile. *(Richter.) Lundell Desm. Suec.* (1871), *p.* 88.

Elongated, subcylindrical, even, ten to twelve times as long as broad, a little or indistinctly constricted in the centre; segments a little attenuated towards the truncate apices, with about eight undulations.

SIZE. 0·21-0·26 mm. × 20-35 μ (Ri.); 0·175 mm. × 14 μ (L.).

Pleurotænium (Docidium) nobile, Richter in Hedwigia (1865), iv., p. 129. Archer in Micr. Journ. xii. (1872), p. 36. Rabh. Alg. Eur. (1868), p. 142.

HAB. Amongst *Sphagnum*.

Ireland, Sweden, Germany.

Plate VII., fig. 3. *a*, living cell; *b*, empty cell; *c*, end of empty cell urther magnified.

Docidium Ehrenbergii. *Ralfs. Desm.* (1848), *p.* 157, *t.* 26, *f.* 4.

Segments many times longer than broad, having two or three slight inflations at the base, and truncate ends, bordered by minute tubercles.

SIZE. 180-450 × 25-35 μ (W.); 0·62-0·74 mm. × 36 μ (D.); 180-450 × 25-35 μ (K.).

Brebisson Liste Desm. (1856), p. 147. Archer in Prit. Inf. (1861), p. 745, t. 2, f. 8 and 11; t. 3, f. 46, 47. Grunow Desm. Austr. (1858), p. 497. Jacobsen Desm. Denm. (1874), p. 179.

Closterium trabecula, Ehr. Abh. Berl. Ak. (1830), p. 62. Ehr. Infus. p. 93, t. 6, f. 2.

Pleurotœnium Ehrenbergii, De Bary Conj. (1858), p. 75. Delponte Desm. p. 132, t. 20, f. 1-7. Nordstedt Norges Desm. (1873), p. 46.

Docidium trabecula, Wolle Desm. U.S. (1884), 48, t. 9, figs. 2, 3, 4, t. 11, f. 1-7. Kirch. Alg. Schles. (1878), 144. Reinsch. Alg. Frank. p. 182. Wittrock Scan. Desm. (1869), p. 21. Jacobsen Desm. Denm. (1874), p. 178.

Pleurotœnium trabecula, Näg. Einz. Alg. (1849), p. 104. Rabh. Alg. Eur. (1868), p. 141. Wood F. Water Algæ U.S. (1872), p. 118. Wille Nov. Sem. (1879), p. 37.

HAB. In pools.

Sussex, Hants, Westmoreland, Gloucester, Middlesex, Cornwall, Wales, Scotland; France, Germany, Italy, Norway, Denmark, United States, Nova Zembla.

Plate VI., fig. 1. *a*, living cell; *b*, empty cell; *d*, zygospore.

var. β **granulatum.** *Ralfs. Desm. p.* 157, *t.* 33, *f.* 4.

Frond rough, with minute granules.

Petit Liste Desm. Paris (1877), p. 29.

Pleurotœnium trabecula, var. b. *granulatum*, Rabh. Alg. Eur. (1868), p. 141.

HAB. In pools.

Sussex, Cornwall.

Plate VI., fig. 1. *c*, empty cell.

Docidium clavatum. *Kutz. in Ralfs. Desm.* (1848), *p.* 156, *t.* 26, *f.* 3.

Segments many times longer than broad with a single inflation at the base; end clavate, but truncate at the apex.

SIZE. Diam. 23-25 μ and 36-42 μ (W.).

Archer in Prit. Inf. (1861), p. 745, t. 2, f. 9. Brebisson Liste Desm. (1856), p. 147. Notaris Desm. Ital. (1867), p. 57, t. 5, f. 56. Wolle Desm. U.S. (1884), p. 48, t. 9, f. 8.

Closterium truncatum, Kutz. Phy. Germ. (1845), p. 133.

Pleurotænium clavatum, D. By. Conj. (1858), p. 75. Lundell Desm. Suec. (1871), p. 89.

Pleurotænium clavatum, Wood F. Water Algæ U.S. (1872), p. 120. Rabh. Alg. Eur. (1868), p. 141.

HAB. In ponds.

Sussex; France, Germany, Sweden, Italy, United States.

Plate VI., fig. 2. *a,* living cell; *b,* empty cell.

Docidium nodulosum. *Breb. in Ralfs. Desm.* (1848), *p.* 155, *t.* 26, *f.* 1.

Frond stout; segments four to six times longer than broad, constricted at regular intervals so as to produce undulated margins; suture projecting on each side.

SIZE. Diam. 40-60 μ (W.); 0·24-0·56 mm. × 58 μ (D.); 40-60 μ diam. (K.).

Brebisson Liste Desm. (1856), p. 147. Archer in Prit. Inf. (1861), p. 745. Petit Liste Desm. Paris (1877), p. 29. Wittrock Scan. Desm. (1869), p. 20. Notaris Desm. Ital. (1867), p. 56, t, 5, f. 44, 45.

Pleurotænium crenulatum, Rabh. Alg. Eur. (1868), p. 142.

Docidium crenulatum (Ehr.), Wolle. Desm. U.S. (1884), p. 47, t. 9, f. 1.

Closterium trabecula, Bailey Amer. Journ. (1841), p. 302, t. 1, f. 32.

Closterium crenulatum, Ehr. Verb. (1843), p. 123, t. 4, f. 29.

Pleurotænium nodulosum, D. By. Conj. (1858), p. 75. Delponte Desm. (1878), t. 19, f. 1-6. Lundell Desm. Suec. (1871), p. 90. Kirch. Alg. Schles. (1878), p. 144. Cleve Över. Desm. (1864), p. 493.

HAB. In pools.

Gloster, Sussex, Hants, Westmoreland, Wales, Scotland; France, Germany, Italy, Sweden, United States.

Plate VI., fig. 3. *a,* living cell; *b,* empty cell.

Docidium truncatum. *Breb. in Ralfs. Desm.* (1848), *p.* 156, *t.* 26, *f.* 2.

Frond stout; segments three or four times longer than road, with a single inflation at the base, tapering to the runcate entire ends, suture projecting on each side.

SIZE. Diam. 50-75 μ (W.); 0·41-0·65 mm. × 43-72 μ D.).

Archer in Prit. Inf. (1861), p. 745. Petit Liste Desm. aris (1877), p. 29. Brebisson Liste Desm. (1856), p. 147. acobsen Desm. Denm. (1874), p. 178. Wolle Desm. U.S. 1884), p. 48, t. 9, f. 6, 7.

Closterium truncatum, Breb. Meneg. Syn. Desm. (1840), p. 235.

Pleurotænium truncatum, D. By. Conj. (1858), p. 104. Delponte Desm. (1878), t. 19, f. 7-11. Cleve Sver. Desm. (1864), p. 494. Nordstedt Norges Desm. (1873), p. 47. Rabh. Alg. Eur. (1868), p. 142. Wille Nov. Sem. (1879), p. 57. Nordstedt Desm. Spitz. (1872), p. 26. Lundell Desm. Suec. (1871), p. 89.

HAB. In pools.

Sussex, Surrey, Cornwall, Wales; France, Germany, Italy, Norway, Sweden, Nova Zembla, United States.

Plate VI., fig. 4. *a*, living cell; *b*, empty cell.

Docidium baculum. *Breb. in Ralfs. Desm.* (1848), *p.* 158, *t.* 33, *f.* 5.

Segments very slender, having a solitary and conspicuous inflation at the base, otherwise linear; vesicles in a single series.

SIZE. 14-22 μ diam. (W.); 0·46-0·6 mm. × 15 μ (D.); 14-22 μ (K.).

Kirch. Alg. Schles. (1878), 144. Archer in Prit. Inf. (1861), p. 745, t. 3, f. 38. Nordstedt Norges Desm. (1873), p. 46. Petit Liste Desm. Paris (1877), p. 29. Wittrock Scan. Desm. (1869), p. 21. Jacobsen Desm. Denm. (1874), p. 179. Wolle Desm. U.S. (1884), p. 49, t. 11, f. 3, 4. Breb. Liste Desm. (1856), p. 147.

Closterium sceptrum, Kutz. Phy. Germ. (1845), p. 133,

Closterium baculum, Breb. Alg. Fal. (1835), p. 59, t. 8.

Closterium trabeculoides, Corda Alm. Carls. (1840), t. 6, f. 44.

Pleurotænium baculum, D. By. Conj. (1858), p. 75. Delponte Desm. (1878), p. 130, t. 20, f. 12-16. Cleve Sver. Desm. (1864), p. 494. Wood F. Water Algæ U.S. (1872), p. 119. Rabh. Alg. Eur. (1868), p. 141.

HAB. In ponds.

Sussex, Gloucester, Lancashire, Westmoreland, Yorkshire, Cornwall, Wales, Scotland; France, Germany, Denmark, Norway, Italy, Sweden, United States.

Plate VII., fig. 4. *a b*, living cells; *c d*, empty cells.

Docidium minutum. *Ralfs. Desm.* (1848), *p.* 158, *t.* 26, *f.* 5.

Frond slender, slightly constricted at the middle, segments linear, not inflated, vesicles in a single series.

SIZE. 7-9 μ or 10-12 μ diam. (W.).

Archer in Prit. Inf. (1861), p. 745. Brebisson Liste Desm. (1856), p. 148. Notaris Desm. Ital. (1867), p. 57, t. 5, f. 57. Jacobsen Desm. Denm. (1874), p. 179. Wolle Desm. U.S. (1884), p. 52, t. 50, f. 29-31, t. 10, f. 9.

Penium minutum, Cleve Sver. Desm. (1864), p. 493. Lundell Desm. Suec. (1871), p. 87. Rabh. Alg. Eur. (1868), p. 122. Wood F. Water Algæ U.S. (1872), p. 107. Nordstedt Norges Desm. (1873), p. 45.

Pleurotænium minutum, Delponte Desm. (1878), t. 20, f. 17-21.

Penium Ralfsii, De Bary Conj. (1858), p. 73, t. 5, f. 8.

HAB. In ponds.

Hants, Sussex, Wales; France, Germany, United States, Italy, Sweden.

Plate VIII., fig. 1. *a b c*, living cells; *d*, empty cell.

Docidium hirsutum. *Bail. Micr. Obs.* (1850), *t.* 1, *f.* 8.

Frond rather slender, suture not prominent, segments four to six times as long as broad, not tapering, inflation obsolete, ends entire, surface all over minutely spinous or hirsute.

SIZE. 23-30 μ diam. (W.).

Archer Prit. Inf. (1861), p. 745. Archer in Quart. Journ. Micr. Sci. (1879), xix., p. 438. Rabh. Alg. Eur. (1868), p. 145. Wolle Desm. U.S. (1884), p. 51, t. 10, f. 13 (?).

Pleurotænium hirsutum, Wood F. Water Algæ U.S. (1872), p. 121.

HAB. In sluggish waters.

Ireland; United States.

Very much resembling a species of *Gonatozygon*.

Plate VII., fig. 5. *a*, living cell; *b*, empty cell.

GENUS 8. CLOSTERIUM. *Nitsch.* (1817).

Frond elongated, attenuated, more or less lunately curved or arcuate, entire, not constricted at the middle, the junction of the segments marked by a pale transverse band. Endochrome often arranged in longitudinal fillets, and at each extremity having a terminal clear space, in which are active granules; empty frond smooth or with longitudinal striæ, never granulated.—*Archer in Pritch. Inf.* 746.

* *Frond scarcely tapering, curvature slight, gradual, and equal, lower margin nearly straight, or slightly concave, ends truncate or broadly rounded.*

Closterium didymotocum. *Corda Alm. Carls.* (1835), *t.* 5, *f.* 64, 65.

Frond stout, six to ten times longer than broad, nearly straight, very slightly tapering to the extremities; upper margin slightly convex, lower nearly straight or very slightly concave, sometimes slightly inclined upwards at the end, ends truncate, reddish, large granules in a single series, empty frond reddish, especially near the ends, striæ faint, central suture evident, sometimes accompanied by two others dividing the frond into four portions.

SIZE. Length 0·37 mm.; breadth 30 μ (R.). Diam. 30-32 μ (W.).

Ralfs. Desm. (1848), p. 169, t. 28, f. 7. Wolle Desm. U.S. (1884), 39, t. 8, f. 12, 13. Archer in Prit. Inf. (1861), p. 746, t. 3, f. 39. Delponte Desm. (1876), p. 104, t. xvii., f. 31-37. Cleve Sver. Desm. (1864), p. 494. Lundell Desm. Suec. (1871), p. 77. Nordstedt Norges Desm. (1873), p. 39. Petit Liste Desm. Paris (1877), p. 28. Wittrock Scan. Desm. (1869), p. 22. Brebisson Liste Desm. (1856), p. 151. Rabh. Alg. Eur. (1868), p. 123. Jacobsen Desm. Denm. (1874), p, 175. Kirch. Schles. 138.

Closterium subrectum, Breb. Alg. Fal. (1835), p. 59, t. 8. Kutz. Phy. Germ. (1845), p. 131.

Closterium turgidum β didymotocum, Klebs. Desm. Pruss. (1879), p. 20.

HAB. In ponds.

Great Britain; France, Germany, Sweden, Norway, Denmark, Italy, United States.

Plate VIII., fig. 2. *a*, living cells; *b c*, empty cells; *d*, end of empty cell.

var. *α*. *Ralfs. Desm.* (1848), *p.* 169, *t.* 28, *f.* 7, *a b.*

Frond with three transverse sutures.

SIZE. 0·52-0·65 mm. × 50-70 μ (C.).

HAB. In pools.

Wales.

var. *β*. **Baileyanum.** *Breb.*

Frond with one transverse suture.

SIZE. 0·38 mm. × 30 μ (C.).

Closterium didymotocum, var. *β Baileyanum*, Breb. in Ralfs. Desm. (1848), p. 169, t. 28, f. 7, *c d*. Rabh. Alg. Eur. (1868), p. 123.

Closterium Baileyanum, Brebisson Liste Desm. (1856), p. 151.

HAB. In ponds, &c.

Sussex, Surrey, Hants, Westmoreland, Cornwall, Wales, Scotland; France.

Plate VIII., fig. 2. *c*, living cells; *e*, empty cells.

Closterium directum. *Archer Micr. Journ.* (1862), ii., *t.* 12, *f.* 23-24.

Frond rather slender, about fifteen to twenty times longer than broad, scarcely curved, nearly straight, linear, ends truncate; fillets indistinct; empty frond very finely and closely striate.

SIZE. 0·28-0·45 mm. × 18 μ (A.).

Lundell Desm. Suec. (1871), p. 78. Nordstedt Norges Desm. (1873), p. 41. Petit Liste Desm. Paris (1877), p. 28. Rabh. Alg. Eur. (1868), p. 127.

Closterium striolatum, var. *a Ulna*, Jacobsen Desm. Denm. (1874), p. 176.

Closterium intermedium b. *directum*, Klebs. Desm. Pruss. (1879), p. 16.

HAB. In mountain pools.

Ireland; France, Germany, Sweden, Norway, Denmark.

Plate VIII., fig. 3. *a*, living cell; *b c*, empty cells.

Closterium obtusum. *Breb. Liste, p.* 154, *t.* 2, *f.* 46.

Frond minute, 4 to 10 times as long as broad, nearly straight, cylindrical, not tapering, upper and lower margin equally and very slightly curved, ends obtusely rounded; large granules in a single series, empty frond smooth.

SIZE. 0.15 mm. × 18 μ (C.). Diam. 5·11 μ (W.); 50 μ × 5 μ (L.).

Archer Micr. Journ. (1876), xvi., p. 338. Pritch. Inf. 746. Lundell Desm. Suec. (1871), p. 77. Klebs. Desm. Pruss. (1879), p. 8. Wolle Desm. U.S. (1884), 38, t. 6, f. 1.

Ireland; Sweden, Germany, France, United States.

Plate X., fig. 4. *a b*, living cells.

** *Frond tapering, curvature slight, lower margin nearly straight, slightly inclined upwards, ends rounded or sub-acute.*

Closterium lunula. *Ehr. Sym. Phys.* (1828), *t.* 2.

Frond large, stout, five or six times as long as broad, semilunate, upper margin very convex, lower nearly straight, somewhat inclined upwards towards the obtuse broadly rounded ends, endochrome with the large granules numerous, scattered, fillets several, distinct, empty frond colourless, without markings, central suture not evident.

SIZE. 0·55 mm. × 90 μ (C.); 0·4 mm. × 76 μ (R.). Diam. 80-110 μ (W).

Ehr. Infus., p. 90, t. 5, f. 15. Ralfs. Desm. (1848), p. 163, t. 27, f. 1. Focke Phys. Stud. (1847), t. 3, f. 18. Archer in Prit. Inf. (1861), p. 747. Corda Alm. Carls. (1835), p. 190, t. 5, f. 56, 57. Delponte Desm. (1878), p. 95, t. 16, f. 1-3. Cleve Sver. Desm. (1864), p. 494. Lundell Desm. Suec. (1871), p. 79. Nordstedt Norges Desm. (1873), p. 41. Petit Liste Desm. Paris (1877), p. 28. Grunow Desm. Austr. (1858), p. 497. Wood F. Water Algæ U.S. (1872), p. 111.

Wolle Desm. U.S. (1884), 40, t. 50, f. 26. Wittrock Scan. Desm. (1869), p. 22. Brebisson Liste Desm. (1856), p. 150. Notaris Desm. Ital. (1867), p. 59, t. 6, f. 61. Rabh. Alg. Eur. (1868), p. 127. Wille Nov. Sem. (1879), p. 59. Jacobsen Desm. Denm. (1874), p. 168. Klebs. Desm. Pruss. (1879), p. 6.

Vibrio lunula, Muller Naturf. (1784), p. 142.

Bacillaria lunula, Schrank Acta Nat. Cur. (1823), p. 533.

Mulleria lunula, Leclerc Mem. Mus. (1802).

Lunulina vulgaris, Bory. Ency. (1824), t. 2.

HAB. In small ponds.

Sussex, Kent, Surrey, Cheshire, Westmoreland, Lancashire, Norfolk, Cornwall, Wales, Scotland, Ireland; France, Germany, Austria, Italy, Norway, Denmark, Sweden, Nova Zembla, United States, Mexico.

Plate VIII., fig. 4. *a*, living cell; *b*, empty cell; *c* empty cell of large form.

Closterium acerosum. *Ehr. Abh. Berl. Akad.* (1831).

Frond slender, six to fifteen times as long as broad, linear lanceolate, gradually tapering, upper margin slightly convex, the lower nearly straight, slightly inclined upwards at the conical ends, large granules in a single central longitudinal series; fillets several, distinct; empty frond colourless, very faintly striated, central suture evident, zygospore orbicular, smooth, placed between the dehiscing deciduous empty fronds.

SIZE. 0·15-0·42 mm. × 17-40 μ (R.); 0·35-0·42 mm. × 22-50 μ (A.). Diam. 35-62 μ (W.)

Ehr. Inf. (1838), p. 92, t. 6, f. 1. Ralfs. Desm. (1848), p. 164, t. 27, f. 2. Archer in Prit. Inf. (1861), p. 747. Hassall Fr. Alg. (1845), p. 374. Delponte Desm. (1878), p. 97, t. 16, f. 4-13. Cleve Sver. Desm. (1864), p. 495. Lundell Desm. Suec. (1871), p. 79. Nordstedt Norges Desm. (1873), p. 41. Petit Liste Desm. Paris (1877), p. 28. Grunow Desm. Austr. (1858), p. 497. Wood F. Water Algæ U.S. (1872), p. 111. Wolle Desm. U.S. (1884), p. 41, t. 6, f. 7, 11, t. 8, f. 17. Wittrock Scan. Desm. (1869), p. 23. Brebisson Liste Desm. (1856), p. 152. Notaris Desm. Ital. (1867), p. 61, t. 8, f. 65. Rabh. Alg. Eur. (1868), p. 128. Wille Nov. Sem. (1879), p. 60. Jacobsen Desm. Denm. (1874), p. 169 (partly). Klebs. Desm. Pruss. (1879), p. 7 (var. *α*). Kirch. Schles. 138.

Vibrio acerosus, Schrank Fauna Bois (1803), p. 47.

HAB. In small ponds and pools.

Sussex, Surrey, Cheshire, Westmoreland, Lancashire, Gloucester, Cornwall, Wales, Scotland; France, Germany, Italy, Norway, Denmark, Sweden, Nova Zembla, United States, Mexico.

Plate IX., fig. 1. *a*, living cell; *b*, empty cell; *c*, zygospore.

var. **acerosum.**

Frond more elongated, striæ more distinct.
SIZE. 0·5-0·76 mm. × 50 μ (R.).

Closterium lanceolatum. *Kutz. Phyc. Germ.* (1845), p. 130.

Frond six to ten times longer than broad, semilanceolate, gradually tapering; upper margin convex, lower nearly straight, inclined upwards towards the tapering subacute ends; large granules in a single central series, fillets several, distinct, empty frond colourless, usually without markings, sometimes faintly striate; central suture evident.
SIZE. 0·37 mm. × 55 μ (R.). Diam. 50-55 μ (W.).
Ralfs. Desm. (1848), p. 163, t. 28, f. 1. Archer in Prit. Inf. (1861), p. 747. Cleve Sver. Desm. (1864), p. 495. Lundell Desm. Suec. (1871), p. 79. Petit Liste Desm. Paris (1877), p. 28. Grunow Desm. Austr. (1858), p. 497. Wittrock Scan. Desm. (1869), p. 22. Brebisson Liste Desm. (1856), p. 152. Rabh. Alg. Eur. (1868), p. 129. Wolle Desm. U.S. (1884), p. 39, t. 8, f. 14.
Cymbella Hopkirkii, Moore Harv. Man. (1841), p. 215.
Closterium acerosum b. lanceolatum, Klebs. Desm. Pruss. (1879), p. 7.

HAB. In pools.

Kent, Westmoreland, Ireland; France, Germany, Austria, Sweden, United States.

Plate IX., fig. 2. *a*, living cell; *b*, empty cell.

Closterium turgidum. *Ehr. Inf.* (1838), p. 95, *t.* 6, *f.* 7.

Frond stout, eight to twelve times as long as broad, semilanceolate, slightly tapering, upper margin convex, with a depression near each extremity; lower margin concave, inclined upwards, towards the rounded ends; large granules in a single longitudinal series, fillets several, empty frond reddish, longitudinal striæ close, distinct, central suture evident.
SIZE. 0·62 mm. × 65 μ (R.); 0·7-1 mm. × 80 μ (C.). Diam. 64-75 μ (W.).
Ralfs. Desm. (1848), p. 165, t. 27, f. 3. Archer in Prit. Inf. (1861), p. 747, t. 3, f. 40. Hassall Fr. Alg. (1845), p. 371. Lundell Desm. Suec (1871), p. 79. Brebisson Liste Desm. (1856), p. 150. Rabh. Alg. Eur. (1868), p. 129. Delponte Desm. Ital. (1878), p. 113, t. 16, f. 24-29. Wolle Desm. U.S. (1884), p. 41, t. 6, f. 15. Kirch. Schles. 138.
Closterium turgidum, a. typicum, Klebs. Desm. Pruss. (1879), p. 20.
HAB. In swamps.

Sussex, Kent, Surrey, Hants, Cheshire, Westmoreland, Cornwall, Wales, Scotland; France, Germany, Italy, Sweden, United States.

Plate IX., fig. 3. *a*, living cell; *b*, empty cell.

Closterium Pritchardianum. *Archer Micr. Journ.* (1862), II. *p.*, 250, *t.* 12, *f.* 25-27.

Frond gradually tapering, ten to fourteen times longer than broad, curvature slight; lower margin very slightly concave, inclined upwards at the tapering conical truncate ends; endochrome with several fillets, and a single longitudinal series of large granules, empty frond very finely striate, reddish near the ends.

SIZE. 0·35-0·5 mm. × 30-35 μ (A.). Sometimes 50 μ broad (C.).

Lundell Desm. Suec. (1871), p. 79. Nordstedt Norges Desm. (1873), p. 41. Nordst. and Wittr. Desm. Ital. (1876), p. 27. Rabh. Alg. Eur. (1868), p. 129.

Closterium lanceolatum. Cleve Bidrag (1864), p. 495, t. 4, f. 7.

HAB. In pools.

Ireland, Wales; Sweden, Norway, Italy.

Plate X., fig. 1. *a*, living cell; *b c*, empty cells; *d*, extremity of empty cell.

Plate XV., fig 7. Zygospore.

Closterium prælongum. *Breb. Liste* (1856), *p.* 152.

Frond very slender, extremely long, thirty-five to forty times as long as broad, slightly curved, very gradually tapering; upper margin slightly convex, with a depression near each extremity; lower concave, inclined upwards towards the rounded ends, large granules in a single series. Empty frond colourless, without markings.

SIZE. 0·78 mm. × 20 μ (A.); 0·87 mm. × 20 μ (D.).

Archer in Prit. Inf. (1861), p. 747. Rabh. Alg. Eur. (1868), p. 130.

HAB. In pools.

Ireland; France.

Plate X., fig 2. *a*, living cell; *b*, empty cell; *c*, zygospore.

⁂ *Frond tapering, lower margin concave, often inflated in the centre, inclined downwards towards rounded or sub-acute ends, empty frond without striæ.*

† *Frond slender, curvature slight.*

Closterium gracile. *Breb. Liste* (1856), *p.* 155, *t.* 2, *f.* 45.

Frond very slender, about twenty-five to thirty times as long as broad, linear, nearly straight, except at the extremities, which are curved downwards, sides parallel, ends obtuse, endochrome arranged in a zigzag or sub-spiral manner. Empty frond without striæ. Zygospore globose smooth.

SIZE. 0·15-0·2 mm. × 5-6 μ; 0·2-0·35 mm. × 8 μ (C.). Diam. 5-6 μ; zygospore 28-30 × 22 μ (W.).
Archer in Prit. Inf. (1861), p. 748. Cleve Sver. Desm. (1864), p. 495. Nordstedt Norges Desm. (1873), p. 40. Jacobsen Desm. Denm. (1874), p. 172. Wolle Desm. U.S. (1884), p 39, t. 6, f. 4, 5. Kirch. Schles. 137.

HAB. In boggy pools.

Ireland; France, Sweden, Norway, Denmark, United States.

C. gracile most resembles *C. juncidum*, but it differs from that species in the arrangement of the endochrome, and also in the empty frond being without striæ.

Plate XIII., fig. 8. *a*, living cell; *b*, empty cell.

†† *Frond lunate, curvature considerable.*

Closterium Ehrenbergii. *Meneg. Syn. Desm.* (1840), *p.* 232.

Frond large, stout, about five or six times as long as broad, lunate, extremities tapering, upper margin very convex, lower concave, with a conspicuous central inflation, ends broadly rounded, large granules, numerous, scattered, fillets several; empty frond colourless, without striæ; central suture not evident. Zygospore orbicular, smooth.
SIZE. 0·37 mm. × 60 μ (R.); 0·32-0·5 mm. × 57-80 μ (D.). Diam. 75-110 μ (W.).
Hassall Fr. Alg. (1845), t. 84, f. 1. Archer in Prit. Inf. (1861), p. 748, t. 16, f. 10 to 14. Ralfs. Desm. (1848), p. 166, t. 28, f. 2. Delponte Desm. (1878), p. 93, t. 16, f. 18-20. Cleve Sver. Desm. (1864), p. 494. Nordstedt Norges Desm. (1873), p. 41. Petit Liste Desm. Paris (1877), p. 28. Grunow Desm. Austr. (1858), p. 497. Wood F. Water Algæ U.S. (1872), p. 113. Wolle Desm. U.S. (1884), p. 45, t. 7, f. 16. Wittrock Scan. Desm. (1869), p. 23. Brebisson Liste Desm. (1856), p. 148. Rabh. Alg. Eur. (1868), p. 131.
Lunulina monilifera, Bory Ency. (1824), t. 3, f. 22, 25, 27.
Closterium lunula, Ehr. Infus. (1838), t. 5, f. xv., 2. Hassall Fr. Alg. (1845), t. 84, f. 42.
Closterium moniliferum forma *Ehrenbergiana*, Jacobsen Desm. Denm. (1874), p. 170.
Closterium moniliferum, *c. Ehrenbergii*, Klebs. Desm. Pruss. (1879), p. 10.

HAB. In ponds and streams.

Widely distributed in England, Wales, Scotland; France, Germany, Italy, Norway, Austria, Sweden, United States.

Plate XII., fig. 2. *a*, living cell; *b*, empty cell.

Closterium moniliferum. *Ehr. Inf.* (1838), *p.* 90, *t.* 5, *f.* 16.

Frond stout, five or six times as long as broad, lunate, extremities tapering; upper margin convex, lower concave, with a central inflation, ends rounded; large granules conspicuous, in a single longitudinal series; empty frond colourless, without striæ, suture not evident.

SIZE. 0·32-0·40 mm. × 50 μ (R.); 0·48-0·8 mm. × 50-70 μ (D.). Diam. 45-55 μ (W.).

Ralfs. Desm. (1848), p. 166, t. 28, f. 3. Archer in Prit. Inf. (1861), p. 748. Hassall Fr. Alg. (1845), p. 370. Delponte Desm. (1878), p. 94, t. 16, f. 21-23. Cleve Sver. Desm. (1864), p. 494. Lundell Desm. Suec. (1871), p. 80. Nordstedt Norges Desm. (1873), p. 42. Nordstedt Desm. Arct. (1875), p. 39. Petit Liste Desm. Paris (1877), p. 28. Grunow Desm. Austr. (1858), p. 497. Wood F. Water Algæ U.S. (1872), p. 113. Brebisson Liste Desm. (1856), p. 149. Wolle Desm. U.S. (1884), p. 45, t. 7, f. 16. Notaris Desm. Ital. (1867), p. 60, t. 6, f. 62. Rabh. Alg. Eur. (1868), p. 131.

Closterium lunula, Kutz. Syn. Desm. (1833), f. 80.

Closterium moniliferum forma *Mulleriana*, Jacobsen Desm. Denm. (1874), p. 170.

Closterium moniliferum a. typicum, Klebs. Desm. Pruss. (1879), p. 9.

HAB. In ponds, pools, &c.

Widely distributed in England, Wales, Scotland, Ireland; France, Germany, Italy, Sweden, Austria, Norway, Russian Lapland, United States.

Plate XII., fig. 3. *a*, living cell; *b*, empty cell.

Closterium Jenneri. *Ralfs. Desm.* (1848), *p.* 167, *t.* 28, *f.* 6.

Frond small, distance between the extremities six or seven times the breadth, crescent-shaped, much curved, gradually tapering, sometimes with an obscure central constriction; upper margin very convex, lower very concave, without a central inflation, ends obtuse, rounded, large granules in a single series, empty frond colourless, without striæ.

SIZE. 87 × 14 μ (R.); 250-18 μ (D.). Diam. 14 μ (W.)

Brebisson Liste Desm. (1856), p. 302. Archer in Prit. Inf. (1861), p. 748. Delponte Desm. (1878), p. 100, t. 17, f. 52, 53. Lundell Desm. Suec. (1871), p. 81. Nordstedt Norges Desm. (1873), p. 42. Wood F. Water Algæ U.S.

(1872), p. 115. Rabh. Alg. Eur. (1868), p. 134. Wille Nov. Sem. (1879), p. 60. Wolle Desm. U.S. (1884), p. 44, t. 7, f. 5.

Closterium moniliferum, Ehr. Inf. (1838), t. 5, f. 16, No. 6, 7.

Closterium Dianæ, c. Jenneri, Klebs. Desm. Pruss. (1879), p. 12.

HAB. Sussex, Surrey, Hants, Cornwall; France, Sweden, Norway, Italy, Nova Zembla, United States.

Plate XIII., fig. 4. *a*, living cell; *b*, empty cell.

Closterium Leibleinii. *Kutz. Syn. Diat.* (1833), *p.* 596.

Frond somewhat stout, distance between the extremities six or eight times the breadth, crescent-shaped, much curved, rapidly attenuated, upper margin very convex, lower very concave, often with a slight central inflation, ends sub-acute; large granules in a single series, fillets few or indistinct. Empty frond somewhat straw-coloured, without striæ, suture evident, zygospore orbicular.

SIZE. 0·85-0·15 mm. × 15-40 μ (R.); 0·22-0·3 mm. × 46-57 μ (D.). Diam. 40-60 μ (W.).

Brebisson Alg. Fal. (1835), p. 58, t. 8. Wolle Desm. U.S. (1884), p. 46, t. 7, f. 13, 20. Archer in Prit. Inf. (1861), p. 748. Ralfs Desm. (1848), p. 167, t. 28, f. 4. Delponte Desm. (1878), p. 98, t. 17, f. 1-6. Cleve Sver. Desm. (1864), p. 494. Lundell Desm. Suec. (1871), p. 80. Petit Liste Desm. Paris (1877), p. 28. Grunow Desm. Austr. (1858), p. 497. Wood F. Water Algæ U.S. (1872), p. 114. Wittrock Scan. Desm. (1869), p. 22. Brebisson Liste Desm. (1856), p. 150. Rabh. Alg. Eur. (1868), p. 132. Wille Nov. Sem. (1879), p. 59.

Closterium lunula, Leibl. Fl. (1827), p. 259.

Closterium moniliferum forma *Leibleiniana*, Jacobsen Desm., Denm. (1874), p. 170.

Closterium moniliferum, b. Leibleinii, Klebs. Desm. Pruss. (1879), p. 9.

HAB. In ponds.

Sussex, Surrey, Cheshire, Gloucester, Yorkshire, Lancashire, Cornwall, Wales, Scotland; France, Germany, Italy, Austria, Sweden, Nova Zembla, United States.

var. β. More slender, scarcely inflated on the lower margin.

Closterium Leibleinii, var. β. Ralfs. Desm. p. 167.

Plate XIII., fig. 1. *a b*, living cells; *c*, empty cells; *d*, zygospore.

Closterium monotænium. *Archer Micr. Journ.* (1876), XVI., *p.* 415.

Small, comparatively stout, curvature slight, inflated in the middle, gradually tapering though still thick towards the apices, which are blunt, rounded; membrane smooth and colourless. Endochrome a single longitudinal band, not plicated; each loculus containing usually a single moving granule, forming a rounded cavity in the plasma, at some distance from the apex.

SIZE.

Ireland.

Closterium Dianæ. *Ehr. Infus.* (1838), *t.* 5, *f.* 17.

Frond slender, six or eight times as long as broad, crescent-shaped, much curved, rapidly attenuated, upper margin very convex, lower very concave without a central inflation, ends sub-acute, with a very slight emargination at the upper outward extremity; large granules in a single series; empty frond somewhat straw-coloured, or faintly reddish, without striæ suture evident. Zygospore globose, smooth.

SIZE. 0·17 mm. × 20 μ (R.); 0·11-0·3 mm. × 10-25 μ (D.); diam. 16-20 μ (W.); zygospore 36 μ (L.).

Ralfs. Desm. (1848), p. 168, t. 28, f. 5. Archer in Prit. Inf. (1861), p. 748. Wolle Desm. U.S. 44, t. 7, f. 8-9, t. 8, f. 4. Hassall Fr. Alg. (1845), p. 371. Delponte Desm. (1878), p. 99, t. 17, f. 45-51. Nordstedt Desm. Arct. (1875), p. 15. Nordstedt Norges Desm. (1873), p. 42. Cleve Sver. Desm. (1864), p. 494. Lundell Desm. Suec. (1871), p. 81. Nordstedt Desm. Arct. (1875), 37-39. Grunow Desm. Austr. (1858), p. 497. Wood F. Water Algæ U.S. (1872), p. 114. Wittrock Scan. Desm. (1869), p. 22. Brebisson Liste Desm. (1856), p. 149. Rabh. Alg. Eur. (1868), p. 133. Wille Nov. Sem. (1879), p. 59. Jacobsen Desm. Denm. (1874), p. 170. Nordstedt Desm. Spitz. (1872), p. 26.

Closterium Venus, Kutz. Phy. Germ. (1845), 130. Petit Liste Desm. Paris (1877), p. 28.

Closterium acuminatum, Kutz. Phy. Germ. (1845), 130.

Closterium ruficeps, Ehr. Abh. Berl. Ak. (1831), p. 67.

Closterium Dianæ a. typicum, Klebs. Desm. Pruss. (1879), p. 11.

HAB. In quiet water.

Sussex, Cheshire, Westmoreland, Wales, Scotland; France, Germany, Italy, Sweden, Norway, Denmark, Austria, Spitzbergen, Nova Zembla, Russian Lapland, United States.

Plate XIII., fig. 3. *a*, living cell; *b*, empty cell.

** *Fronds gradually tapering, curvature often gradual, lower margin concave, inclined downwards at the rounded truncate, or nearly acute ends. Empty frond striate.*

† *Fronds crescent shaped.*

Closterium cynthia. *Not. Desm. Ital.* (1867), *p.* 65, *t.* 7, *f.* 71.

gradually attenuated from the middle towards each extremity, apices obtuse, elegantly arcuate, almost a semicircle. Endochrome dense, interrupted in the middle of the frond. Terminal space occupied by a single active granule, membrane amber colour, delicately striate with 1-3 transverse striæ at the middle. Striæ of the membrane about 10 or 12. Zygospore globose, smooth.

SIZE. 104-160 × 11-18 μ; zygospore 28-31 μ (L.).

Archer Micr. Journ. (1868), viii., p. 118. Lundell Desm. Suec. (1871), p. 78. Nordstedt Norges Desm. (1873), p. 40. Jacobsen Desm. Denm. (1874), p. 176.

Closterium Archerianum c. Cynthia, Klebs. Desm. Pruss. (1879), p. 13.

HAB. In turbaries.

Ireland, Sweden, Norway, Denmark, Italy.

Plate XIII., fig. 2. *a*, living cell; *b*, empty cell.

In some respects *C. cynthia* resembles *C. Jenneri*, but it is a larger species. It is marked by having a solitary, somewhat large granule in the middle of the terminal space, not a cluster of small ones. "It at once catches the eye by its peculiar curvature, differing from that of the much-curved forms at all liable to be mistaken for it. It is not so equally arched, and the ends are more rounded and blunt than in them; in fact it is not so graceful a form as *C. Leibleinii* or *C. D* [illegible] seems most to approach in size. Fro [illegible] striolate."

Closterium Archerianum. *Cleve in Lundell Desm. Suec. p.* 77, *t.* 5, *f.* 13.

Narrowly lanceolate, ten times longer than broad, equally curved, semilunar or semicircular, ventral side not swollen, somewhat obtuse at each apex, more or less extended, equally attenuated, 2-4 striæ transversely in the centre, membrane yellow, becoming brownish, longitudinally striate, with about 10 striæ, amylaceous granules disposed in a single series.

SIZE. 196-230 × 18-21 μ (L.).

Archer Micr. Journ. xiii. (1873), p. 213. Nordstedt Norges Desm. (1873), p. 40. Jacobsen Desm. Denm. (1874), p, 175.

Closterium Archerianum a. typicum, Klebs. Desm. Pruss. (1879), p. 13.

N. Wales, Ireland, Norway, Denmark, Germany.

Plate XIII., fig. 5. *a*, living cell; *b*, empty cell.

Closterium calosporum. *Wittr. Anteck.* (1869), *p.* 23, *f.* 11.

Small, semilunate, not swollen in the middle, slender, 6 to 9 times as long as broad, acuminate at the apices, vesicles in a single series, empty frond at length very delicately striate. Zygospore globose, furnished with conical processes.

SIZE. 70-95 × 10-12 μ; zygospore 20 μ.

Archer Micr. Journ. (1873), xiii., p. 100. Lundell Desm. Suec. (1871), p. 81. Wille Nov. Sem. (1879), p. 60.

Ireland; Sweden, Nova Zembla.

Plate XIII., fig. 6. *a*, living cells; *b*, empty cells; *c*, zygospores.

Closterium lagoense. *Nordst. Videns. Meddl. Kjob.* (1869), *p.* 203. *t.* 2, *f.* 2.

Lanceolate, six to seven times longer than broad, somewhat semi-lunar, not inflated at the centre, a little spreading at the extremities, with the apices a very little dilated, rather obtuse, suddenly attenuated, three transverse striæ in the middle, membrane becoming brownish, longitudinally striate, with about 16 striæ. Vesicles about 5 in each segment disposed in a central series.

SIZE. Long 138-166 μ; broad, 25-28 μ.

Archer Micr. Journ. (1873), xiii., p. 213.

Ireland; Brazil.

Plate XII., fig. 5. *a*, living cell; *b*, empty cell.

†† *Fronds slightly curved, not lunate.*

Closterium costatum. *Corda. Alm. Carls.* (1835), *t.* 5, *f.* 61.

Frond stout, about five or six times as long as broad, lunate, attenuated; upper margin convex, lower concave, ends obtuse, rounded; large granules in a single series; empty frond reddish; striæ few (about six), conspicuous; suture evident. Zygospore globose or ovoid-globose, smooth.

SIZE. 0·32 mm. × 65 μ (R.); diam. 63-70 μ (W.); zygospore 100-120 μ (L.).

Ralfs. Desm. (1848), p. 170, t. 29, f. 1. Archer in Prit. Inf. (1861), p. 748. Cleve Sver. Desm. (1864), p. 494. Lundell Desm. Suec. (1871), p. 78. Nordstedt Norges Desm. (1873), p. 40. Brebisson Liste Desm. (1856), p. 148. Notaris Desm. Ital. (1867), p. 62, t. 7, f. 66. Rabh. Alg. Eur. (1868), p. 126. Jacobsen Desm. Denm. (1874), p. 174. Wolle Desm. U.S., p. 42, t. 6, f. 19. Kirch. Schles. 139.

Closterium doliolatum, Breb. Meneg. Syn. Desm. (1840), p. 237.

Closterium turgidulum, Kutz. Phyc. Germ. (1845), 132.

Closterium dilatatum, Kutz. Phy. Germ. (1845), p. 132.

Closterium striolatium b. costatum, Klebs. Desm. Pruss. (1879), p. 14.

HAB. In marsh pools and bogs.

Sussex, Surrey, Hants, Gloster, Westmoreland, Cornwall, Wales, Scotland; France, Germany, Sweden, Italy, Norway, Denmark, United States.

Plate X., fig. 3. *a*, living cell; *b*, empty cell.

Closterium striolatum. *Ehr. Abh. Berl. Akad.* (1833), *p.* 68.

Frond from six to ten times as long as broad, lunate, attenuated; upper margin convex slightly depressed in the centre, lower concave, ends very obtuse, rounded; large granules in a single series; empty frond reddish, especially near the ends; striæ very numerous, crowded, transverse sutures usually three. Zygospore orbicular, smooth.

SIZE. 0·3-0·37 mm. × 40-45 μ (R.). Diam. 38-40 μ (W.).

Ehr. Infus. (1838), t. 6, f. 12. Hassall Fr. Alg., p. 373. Archer in Prit. Inf. (1861), p. 749, t. 2, f. 2 and 6. Wolle Desm. U.S. (1884), p. 42, t. 6, f. 8, 20. Ralfs. Desm. (1848), p. 171, t. 29, f. 2. Cleve Sver. Desm. (1864), p. 494. Lundell Desm. Suec. (1871), p. 77. Nordstedt Norges Desm. (1873), 39. Nordstedt Desm. Arct. (1875), p. 37, 39. Petit Liste Desm. Paris (1877), p. 28. Wood F. Water Algæ U.S., (1872), p. 109. Wittrock Scan. Desm. (1869), p. 23. Brebisson Liste Desm. (1856), p. 153. Notaris Desm. Ital. (1867), p. 62, t. 7, f. 67. Rabh. Alg. Eur. (1868), p. 125 (excl. var. b.). Wille Nov. Sem. (1879), p. 61. Nordstedt. Desm. Spitz. (1872), p. 25. Kirch. Schles. 139.

Closterium striolatum, var. *a. vulgaris*, Jacobsen Desm. Denm. (1874), p. 176.

Closterium striolatum a. typicum, Klebs. Desm. Pruss. (1879), p. 14.

HAB. In shallow pools.

Widely distributed in England, Wales, Scotland, Ireland; France, Germany, Italy, Sweden, Norway, Nova Zembla, Russian Lapland, United States.

Plate XI., fig. 1. *a*, living cell; *b c*, empty cells; *d*, zygospore.

Closterium intermedium. *Ralfs. Desm.* (1848), *p.* 171, *t.* 29, *f.* 3.

Frond slender, twelve to fifteen times as long as broad, slightly curved, very gently tapering, upper margin convex, gradually arched, lower slightly concave; ends obtuse, rounded; large granules in a single series; empty frond pale straw-coloured, striæ distinct, numerous, but not crowded; transverse sutures usually more than three. Zygospore globose, smooth.

SIZE. 0·32-0·45 mm. × 22 μ (R.); zygospore 54 μ (L.).

Ralfs. Brit. Algæ Exs. No. 29. Archer in Prit. Inf. (1861), p. 749. Cleve Sver. Desm. (1864), p. 495. Lundell Desm. Suec. (1871), p. 77. Nordstedt Norges Desm. (1873), p. 40. Petit Liste Desm. Paris (1877), p. 28. Wittrock Scan. Desm. (1869), p. 23. Brebisson Liste Desm. (1856), p. 153.

Closterium striolatum, var. *β. intermedia*, Jacobsen Desm. Denm. (1874), p. 176.

Closterium intermedium a. typicum, Klebs. Desm. Pruss. (1879), p. 16.

Closterium striolatum, var. *b.*, *elongatum*, Rabh. Alg. Eur. (1868), p. 126.

HAB.

Wales; France, Germany, Sweden, Norway.

Plate XI., fig. 2. *a*, living cell; b, empty cell.

Plate XV., fig. 6. Empty cells.

Closterium angustatum. *Kutz. Phyc. Germ.* (1845), *p.* 132.

Frond slender, ten to twenty times as long as broad, sublinear, slightly curved, scarcely attenuated, upper margin convex, gradual, lower concave; ends truncate, slightly rounded; large granules in a single series; empty frond pale reddish, especially, near the ends, striæ few (about four), very distinct, transverse sutures usually three.

SIZE. 0·4 mm. × 21 μ (R.); diam. 15-25 μ (W.).

Ralfs. Desm. (1848), p. 172, t. 29, f. 4. Archer in Prit. Inf. (1861), p. 749. Wolle Desm. U.S. (1884), p. 40, t. 6, f. 21-23. Lundell Desm. Suec. (1871), p. 78. Nordstedt Norges Desm. (1873), p. 40. Petit Liste Desm. Paris (1877), p. 28. Wood F. Water Algæ U.S. (1872), p. 110. Wittrock Scan. Desm. (1869), p. 23. Brebisson Liste Desm. (1856), p. 153. Notaris Desm. Ital. (1867), p. 66, t. 8, f. 72. Rabh. Alg. Eur. (1868), p. 126. Jacobsen Desm. Denm. (1874), p. 176.

Closterium sulcatum, Breb. in litt. fide Ralfs.

HAB. In ponds.

Sussex, Surrey, Westmoreland, Wales, Scotland; France, Germany, Norway, Sweden, Italy, Denmark, United States.

Plate XI., fig. 3. *a*, living cell; *b*, empty cell; *c*, portion enlarged.

Closterium juncidum. *Ralfs. Desm.* (1848), *p.* 172, *t.* 29, *f.* 6.

Frond very slender, fifteen to even thirty-five times as long as broad, linear, straight, except towards the extremities, which are somewhat curved downwards, ends obtuse, empty frond nearly colourless, striæ not numerous, faint; transverse sutures usually three. Zygospore orbicular, smooth.

SIZE. 0·22-0·37 mm. × 5 μ (R.) ; 0·22-0·46 mm. × 7-14 μ (D.). Diam. 11-12 μ (W.).

Wolle Desm. U.S. (1884), p. 38, t. 6, f. 2, 3. Archer in Prit. Inf. (1861), p. 749. Delponte Desm. (1878), p. 115, t. 17, f. 11-14. Cleve Sver. Desm. (1864), p. 495. Lundell Desm. Suec. (1871), p. 78. Nordstedt Norges Desm. (1873), p. 40. Nordstedt Desm. Arct. (1875), p. 39. Petit Liste Desm. Paris (1877), p. 28. Grunow Desm. Austr. (1858), p. 501. Wood F. Water Algæ U.S. (1872), p. 110. Wittrock Scan. Desm. (1869), p. 23. Brebisson Liste Desm. (1856), p. 152. Notaris Desm. Ital. (1867), p. 64, t. 7, f. 69. Rabh. Alg. Eur. (1868), p. 127. Jacobsen Desm. Denm. (1874), p. 176.

Closterium intermedium c. juncidum, Klebs. Desm. Pruss. (1879), p. 16.

HAB. In ponds.

Sussex, Cheshire, Westmoreland, Cornwall, Wales ; France, Germany, Italy, Sweden, Denmark, Norway, Austria, Russian Lapland, United States.

var. *β*. Frond stouter, less elongated.

Closterium juncidum, var. *β*, Ralfs. Desm. p. 173, t. 2967.

HAB. In ponds.

Sussex, Wales.

Plate XIII., fig. 7. *a*, living cells ; *b*, empty cells ; *c*. zygospore.

Closterium lineatum, *Ehr. Abh. Berl. Akad.* (1833), *p.* 238.

Frond slender, elongated, eighteen to twenty or twenty-five times as long as broad, gently curved, very gradually attenuated, upper margin unequally convex, being most curved near the ends, lower concave, or somewhat protuberant at the centre, sides somewhat parallel for a portion of their length, extremities gradually tapering, slender, curved downwards, ends obtuse ; large granules in a single series, empty frond reddish, striæ numerous, distinct, one or more transverse lines at the suture. Zygospore double, rounded, smooth.

SIZE. 0·5 mm. × 26 μ (R.) ; 0·43-0·72 mm. × 21-28 μ (D.). Diam. 24-36 μ (W.).

Ehr. Infus. (1838), t. 6, f. 8. Wolle Desm. U.S. (1884), p. 43, t. 6, f. 16. Archer in Prit. Inf. (1861), p. 749, t. 3, f. 41, 42. Hassall Fr. Alg. (1845), p. 372. Ralfs. Desm. (1848), p. 173, t. 30, f, 1. Delponte Desm. (1878), p. 117, t. 17, f. 28-30. Cleve Sver. Desm. (1864), p. 495. Lundell Desm. Suec. (1871), p. 79. Wood F. Water Algæ U.S. (1872), p. 112. Brebisson Liste Desm. (1856), p. 152. Rabh. Alg. Eur. (1868), p. 130. Jacobsen Desm. Denm. (1874), p. 174.

Hab. Sussex, Lancashire, Cornwall, Wales, Scotland; France, Germany, Italy, Denmark, Sweden, Mexico, United States.

var. β. Striæ equal.

Closterium lineatum, var. β. Ralfs. Desm. p. 173.

var. γ. Striæ very faint except at the centre of the frond.

Closterium lineatum, var. γ. Archer in Prit. Inf. (1861), p. 749.

Plate XII., fig. 1. *a*, living cell; *b*, empty cell.

Plate XV., fig. 5. Abnormal zygospore, single.

** *** *Frond gradually curved, suddenly contracted at the end to a conical point.*

Closterium attenuatum, *Ehr. Inf.* (1838), *t.* 6, *f.* 4.

Frond eight to twelve times as long as broad, gently curved, gradually attenuated, upper margin slightly convex, lower concave; extremities suddenly contracted into an obtuse conical point; large granules in a single series; empty frond reddish, with numerous close striæ, central suture evident.

Size. 0·42 mm. × 38 μ (R.); 0·36-0·5 mm. × 36 μ (D.). Diam. 34-42 μ (W.).

Ralfs. Desm. (1848), p. 169, t. 29, f. 5. Wolle Desm. U.S. (1884), p. 41, t. 8, f. 5. Archer in Prit. Inf. (1861), p. 749, t. 3, f. 43. Lundell Desm. Suec. (1871), p. 79. Brebisson Liste Desm. (1856), p. 153. Rabh. Alg. Eur. (1868), p. 130. Jacobsen Desm. Denm. (1874), p. 174.

Closterium candianum, Delponte Desm. (1878), p. 114, t, 17, f. 7-10. (?)

Hab. Kent, Sussex, Surrey, Westmoreland, Cornwall, Wales; France, Germany, Italy, Sweden, Denmark, United States.

Plate XIV., fig. 1. *a*, living cell; *b*, empty cell.

*** *** *Frond ventricose or narrowly lanceolate, tapering rapidly into a distinct beak.*

Closterium Ralfsii, *Breb. in Ralfs. Desm.* (1848), *p.* 174, *t.* 30, *f.* 2.

Frond stout, six to nine times as long as broad, the upper margin slightly convex, lower concave, ventricose at the middle, each extremity tapering into a narrow slender reddish beak, shorter than the body, slightly curved downwards, ends obtuse; large granules conspicuous in a single series; empty frond reddish, especially near the ends; striæ numerous, close and distinct, central suture accompanied by several transverse lines.

Size. 0·3 mm. × 50 μ (R.); diam. 42-47 μ (W.).

Ralfs. Brit. Algæ Exs., No. 30. Wolle Desm. U.S. (1884), p. 46, t. 7, f. 10. Archer in Prit. Inf. (1861), p. 749. Lundell Desm. Suec. (1871), p. 81. Nordstedt Norges Desm. (1873), p. 42. Brebisson Liste Desm. (1856), p. 155. Rabh. Alg. Eur. (1868), p. 135.

Closterium rostratum, Ralfs. in Jenner Fl. Tunb. (1845), p. 196.

Closterium Ralfsii b. typicum, Klebs. Desm. Pruss. (1879), p. 18, t. 2, f. 6, *b*, *c*.

Hab. In ponds.

Kent, Sussex, Lancashire, Westmoreland, Cornwall, Norfolk, Wales, Scotland; France, United States.

Plate XIV., fig. 2. *a*, living cell; *b*, empty cell.

Plate XV., fig. 8. *a*, empty cell.

Closterium rostratum. *Ehr. Abh. Berl. Akad.* (1831), *p.* 67.

Frond from ten to fifteen times as long as broad, lanceolate, upper and lower margins nearly equally convex; each extremity tapering into a narrow setaceous, nearly colourless beak, nearly equal in length to the body, curved downwards, ends obtuse, large granules in a single series, empty frond colourless, or faintly straw-coloured, striæ numerous, close, suture solitary, zygospore somewhat cruciform, with concave sides.

Size. 0·37 mm. × 23 μ (R.); 0·37 mm. × 35 μ (A.); 0·4-0·59 mm. × 21-28 μ (D.); diam. 23-40 μ (W.).

Ehr. Infus. (1838), t. 6, f. 10. Meneg. Syn. (1840), p. 233. Archer in Prit. Inf. (1861), p. 749, t. 3, f. 44. Ralfs. Desm. (1848), p. 175, t. 30, f. 3. Delponte Desm. (1878), p. 118, t. 17, f. 63-68. Cleve Sver. Desm. (1864), p. 495. Lundell Desm. Suec. (1871), p. 81. Nordstedt Norges Desm. (1873), p. 42. Nordstedt Desm. Arct. (1875), p. 37. Petit Liste Desm. Paris (1877), p. 28. Wolle Desm. U.S. (1884), p. 46, t. 8. f. 1-3. Wood F. Water Algæ. U.S. (1872), p. 115. Brebisson Liste Desm. (1856), p. 156. Notaris Desm. Ital. (1867), p. 66, t. 8, f. 73. Rabh. Alg. Eur. (1868), p. 135. Wille Nov. Sem. (1879), p. 60. Klebs. Desm. Pruss. (1879), p. 18.

Closterium acus, Nits. in Kutz. Syn. Diat. (1833), p. 595. f. 81.

Closterium caudatum, Corda Alm. Carls. (1835), t. 5, f. 66.

Stauroceras acus, Kutz. Phy. Germ. (1845), p. 133. Grunow Desm. Anstr. (1858), p. 497.

Hab. In ponds.

Kent, Sussex, Gloucester, Cheshire, Westmoreland, Lancashire, Cornwall, Wales, Scotland; France, Germany, Italy, Sweden, Nova Zembla, United States.

Plate XIV., fig. 3. *a*, living cell; *b*, empty cell; *c*, *d*, *e*, conjugation and development of zygospore, after De Bary.

Closterium setaceum. *Ehr. Abh. Berl. Akad.* (1833), *p.* 239.

Frond very slender, twenty to twenty-five times as long as broad, narrow lanceolate, upper and lower margins nearly equally and but slightly convex; each extremity tapering into a very long, slender, setaceous, colourless beak, longer than the body, ultimately curved downwards, ends obtuse; empty frond colourless, striæ close, faint, central suture solitary, zygospore cruciform.

Size. 0·21 mm. × 10 μ (R.); 0·36-05 mm. × 18-32 μ (D.); diam. 10-11 μ (W.).

Ehr. Inf. (1838), t. 6, f. 11. Hassall Fr. Alg. (1845), p. 373. Archer in Prit. Inf. (1861), p. 750. Wolle Desm. U.S. p. 47, t. 8, f. 6-11. Delponte Desm. (1878), p. 105, t. 17, f. 41-44. Lundell Desm. Suec. (1871), p. 81. Nordstedt Norges Desm. (1873), p. 42. Petit Liste Desm. Paris (1877), p. 28. Wood F. Water Algæ U.S. (1872), p. 116. Brebisson Liste Desm. (1856), p. 156. Notaris Desm. Ital. 1867, p. 67, t. 8, f. 74. Rabh. Alg. Eur. (1868), p. 136. Jacobsen Desm. Denm. (1874), p. 174.

Stauroceras subulatum, Kutz. Phy. Germ. (1845), p. 133. Grunow Desm. Austr. (1858), p. 497.

Stauroceras intermedium, Kutz. Sp. Alg. (1849), p. 166.

Closterium rostratum, Bailey Amer. Journ. (1841), t. 1, f. 36.

Closterium (Asteroselene) setaceum, Wittrock Scan. Desm. (1869), p. 24.

Closterium rostratum c. setaceum, Klebs. Desm. Pruss. (1879), p. 18.

Hab. In ponds.

Sussex, Gloucester, Wales, Scotland; France, Germany, Italy, United States.

Plate XIV., fig. 4. *a*, living cell; *b*, empty cell; *c*, formation of zygospore.

Closterium Kutzingii. *Breb. Liste* (1856), *p.* 156, *t.* 2, *f.* 40.

Similar to *C. rostratum*, but smaller, straight in the middle, narrow lanceolate, each extremity tapering into a long, slender, setaceous beak, which is curved at the obtuse ends, and less than the length of the body.

Size. Diam. 17 μ (W.).

Wolle Desm. U.S., p. 47, t. 8, f. 8. Lund. Desm. Suec. (1871), p. 81.

Hab. In ponds.

France, United States, Sweden.

Plate XV., fig. 3. *a*, living cell; *b*, empty cell.

***
**** *Frond minute, tapering, curvature very slight, neither inflated nor rostrate.*

Closterium cornu. *Ehr. Abh. Berl. Akad.* (1830), *p.* 62

Frond minute, five to eight times as long as broad, slender, slightly curved, attenuated, ends blunt; endochrome not reaching to the extremities; large granules indistinct, in a single series; empty frond colourless, without striæ. Zygospore quadrate in front view, elliptic in end view.

Size. 0·17 mm. × 6½ μ (R.).

Ehr. Inf. (1838), t. 6, f. 5. Archer in Prit. Inf. (1861), p. 750. Ralfs. Desm. (1848), p. 176, t. 30, f. 6. Cleve Sver. Desm. (1864), p. 495. Lundell Desm. Suec. (1871), p. 82. Nordstedt Norges Desm. (1873), p. 42. Petit Liste Desm. Paris (1877), p. 28. Brebisson Liste Desm. (1856), p. 154. Rabh. Alg. Eur. (1868), p. 137. Wille Nov. Sem. (1879), p. 59.

Closterium pronum c. cornu, Klebs. Desm. Pruss. (1879), p. 19.

Stauroceras cornu, Grunow Desm. Austr. (1858), p. 497.

Closterium tenue, Kutz. Syn. Diat. (1833), p. 595, f. 78.

Hab. In boggy waters.

Sussex, Westmoreland, Wales; France, Germany, Italy, Sweden, Nova Zembla.

var. β. Frond more turgid.

Size. 0·11 mm. × 11 μ (R.).

Britain, France.

Plate XII., fig. 4 *a*, living cell; *b*, empty cell.

Closterium acutum. *Breb. in Ralfs. Desm.* (1848), *p.* 177, *t.* 30, *f.* 5, *t.* 34, *f.* 5.

Frond small, slender, from six to twenty times as long as broad, narrow lanceolate, slightly curved, gradually attenuated, ends acute, empty frond colourless, without striæ. Zygospore somewhat quadrate in front view, end view elliptic.

Size. 0·14 mm. × 10 μ (R.); 0·11 mm. × 12 μ (N.); diam. 9-11 μ (W.).

Wolle Desm. U.S. (1884), p. 44, t. 7, f. 11-12. Archer in Prit. Inf. (1861), p. 750. Nordstedt Desm. Arct. (1875). p. 15. Cleve Sver. Desm. (1864), p. 495. Lundell Desm. Suec. (1871), p. 82. Nordstedt Norges Desm. (1873), p. 42. Brebisson Liste Desm. (1856), p. 154. Rabh. Alg. Eur. (1868), p. 137. Wille Nov. Sem. (1879), p. 61.

Closterium (Asteroselene) acutum, Wittrock Scan. Desm. (1869), p. 24.

Closterium pronum b. acutum, Klebs. Desm. Pruss. (1879), p. 19.

Stauroceras acutum, Grunow Desm. Austr. (1858), p. 497.

Echinella acuta, Lyngb. Hydrophy. Dan. (1819), t. 69, G.

Frustulia acuta, Kutz. Syn. Diat. (1833), p. 537.

Closterium tenerrimum, Kutz. Phy. Germ. (1845), p. 130.

HAB. In marshy and boggy pools.

Sussex, Cornwall, Wales, Lancashire; France, Germany, Spitzbergen, Sweden, Denmark, Nova Zembla, United States.

Plate XIV., fig. 5. *a*, living cells; *b*, empty cells; *c*, formation of zygospore.

var. *α*. *Ralfs. Desm. p.* 177.

Six to twelve times as long as broad, ends subacute.

Closterium subulatum. (*Kutz.*) *Syn. Diat.* 1833, *p.* 538, *f.* 3.

Ten to twenty times as long as broad. Frond slender, narrowly lanceolate, slightly and gradually curved and attenuated to the very acute ends. Empty frond colourless, without striæ.

SIZE. Diam. of *C. acutum*, length greater.

Brebisson Liste (1856), p. 154. Notaris Desm. Ital. 62, t. 6, f. 64.

Frustulia subulata, Kutz. Syn. Diat. (1833), p. 538, f. 3.

Stauroceras subulatum, Breb. fide Ralfs.

Closterium acutum, var. *β*, Ralfs. Desm (1848), p. 177, t. 30, f. 5, *c*.

HAB. Amongst *Sphagnum*.

Plate XV., fig. 4. *a*, living cell; *b*, empty cell.

Closterium aciculare. *West. Micr. Journ.* (1860), VIII., *p.* 153, *t.* 7, *f.* 16.

Frond elongated, very slender, straight, except at the extremities, which are very slightly curved downwards, gradually tapering from the centre to the very acute ends. Empty frond not striate.

SIZE. 0·5 mm. long; 5 μ broad.

Archer Micr. Journ. ii. (1862), p. 31; (1866), vi., p. 181.

HAB. In pools.

Yorkshire, Northumberland.

Plate XV., fig. 1. *a,* living cell; *b,* empty cell.

Closterium linea. *Perty. Kleins. Lebens.* (1852), *p.* 206, *t.* 16, *f.* 20.

Small, slender, straight, gradually attenuated from the centre to each acute extremity. Empty frond without striæ. Zygospore sub-cruciate, elliptic in side view.

SIZE. Diam. 9 μ; 42 times as long (L.); 150 × 3½ μ (C.).

Archer Micr. Journ. (1866), vi., pp. 71. Lundell Desm. Suec. (1871), p. 82. Rabh. Alg. Eur. (1868), p. 139.

Closterium pronum d. linea, Klebs. Desm. Pruss. (1879), p. 19.

HAB. Floating on the surface of pools.

Ireland, Essex; Switzerland.

Plate XV., fig. 2. *a,* living cell; *b,* empty cell.

Closterium Griffithii. *Berk. in Micro. Dict., Ed.* III., *p.* 176.

Frond minute, scarcely curved, acicular, very acute, smooth.

Archer in Prit. Inf. (1861), p. 750.

Closterium subtile, Breb. (?)

Our knowledge of this obscure species is very imperfect.

Species omitted.

Closterium eboracense. *Turner in Trans. Leeds Nat. Club,* 1886.

Frond semilunate, four times as long as broad, ends broadly rounded, upper margin convex, lower concave, never inflated in the centre, large granules conspicuous in a longitudinal series, empty frond colourless, without striæ, central suture indistinct.

SIZE. 200-220 μ long; 50-57 μ broad (T.).

Closterium cucumis, Wolle (not Ehr.), Desm. U.S., p. 40, t. 6, f. 17, 18.

HAB. In ponds.

Campsall, Doncaster; Chapeltown, Leeds.

From data and figures kindly furnished by Mr. W. B. Turner, but too late for insertion in their proper place. Figures will be given hereafter.

GENUS 9. **PENIUM.** *Breb.* (1848).

Frond elongate, straight, cylindrical, elliptic, or lanceolate, either not at all constricted, or but very slightly narrowed at the middle, entire. Endochrome with or without a terminal clear space, containing active granules.—*Archer in Pritch. Infus.* 750.

A. *Empty frond granulate.*

Penium margaritaceum. *Breb. in Ralfs. Desm., p.* 149, *t.* 25, *f.* 1.

Frond six to ten times as long as broad, fusiform or cylindrical, with rounded-truncate ends, rough with pearly granules arranged in longitudinal lines. Endochrome at each end sometimes with a more or less distinct terminal cavity with active granules. Zygospore orbicular, smooth.

SIZE. Length 225 μ; diam. 24-28 μ (W.); length 115-136 μ; diam. 22-25 μ (D.); diam. 24-28 μ (K.).

Breb. Liste Desm. (1856), p. 146. Archer in Prit. Inf. (1861), p. 750. Delponte Desm. (1878), t. 15, f. 43-50. Notaris Desm. Ital. (1867), t. 8, f. 79. Cleve Sver. Desm. (1864), p. 493. Lundell Desm. Suec. (1871), p. 85. Nordstedt Norges Desm. (1873), p. 44. Wood Algæ U.S. (1872), p. 107. Klebs. Desm. Pruss. (1879), p. 21. Rabh. Alg. Eur. (1868), p. 121. Nordstedt Desm. Spitz. (1872), p. 25. Wolle. Desm. U.S. (1884), p. 34, t. 5, f. 5, 6, 11. Kirch. Alg. Schles. (1878), p. 135.

Closterium margaritaceum, Ehr. Inf. (1838), t. 6, f. 13. Hassall Fr. Alg. (1845), p. 376.

HAB. In pools, &c.

Great Britain; France, Germany, Italy, Sweden, Norway, United States, New Zealand.

Plate XVII., fig. 1; *a c e*, living fronds; *b d f*, empty fronds; *g*, zygospore.

var. α. *Archer in Pritch. Infus., p.* 750, *t.* 2, *f.* 14.

Frond fusiform, gradually constricted at the middle, granules distinct.

Sussex, Cornwall.

var β. *Ralfs. Desm., p.* 149, *t.* 33, *f.* 3.

Frond linear, scarcely contracted at the middle, granules distinct.

Sussex, Gloucester.

var. γ. **punctatum.** *Ralfs. Desm. p.* 149, *t.* 25, *f.* 1.

Frond linear, not contracted at the middle, granules appearing like puncta.

Sussex, Surrey, Westmoreland, Wales, Scotland.

Plate XVII., fig. 1. *h*, empty frond of this variety.

Penium cylindrus. *Breb. in Ralfs. Desm. p.* 150, *t.* 25, *f.* 2.

Frond minute, reddish, three or four times as long as broad, cylindrical, not contracted at the middle, ends rounded-truncate, rough with minute, closely scattered, pearly granules. Empty frond red ; zygospore globose, smooth.

SIZE. Diam. 13-20 μ ; zygospore 20 μ (K.) ; length 50-57 μ ; diam. 25 μ (D.).

Breb. Liste Desm. (1856), p. 146. Archer in Prit. Inf. (1861), p. 750. Delponte Desm. (1878), t. 15, f. 29-33. Lundell Desm. Suec. (1871), p. 85. Nordstedt Norges Desm. (1873), p. 44. Petit Liste Desm. Paris (1877), p. 28. Grunow Desm. Austr. (1858), p. 501. Notaris Desm. Ital. (1867), p. 70, t. 8, f. 81. Rabh. Alg. Eur. (1868), p. 122.

Closterium cylindrus, Ehr. Infus. (1838), t. 6, f. 6. Kutz. Phy. Germ., p. 132.

Dysphinctium cylindrus, Nag. Einz. Alg. (1849), p. 111.

Calocylindrus cylindrus, Kirch. Alg. Schl. (1878), p. 142.

HAB. In ponds.

Sussex, Westmoreland, Cornwall, Wales ; France, Germany, Italy, Sweden, Norway, Austria.

Plate XVII., fig. 2. *a a*, living fronds ; *b*, empty frond.

B. *Empty frond striate.*

Penium spirostriolatum. *Barker in Micr. Journ.* (1869), IX., *p.* 194.

Rather large, elongated, somewhat attenuated at the centre, and tapering slightly towards the rotundato-truncate ends. Cell membrane with a number of rather coarse striæ, running in a spiral direction, these somewhat interrupted at a number of annular rib-like projections, which are most numerous towards the upper third of the segment.

SIZE. Length 155-225 μ ; diam. 17-23 μ (N.).

Wittrock and Nordstedt Algæ Exsic., No. 574.

Closterium spiraliferum, Jacobs. Desm. Denm., t. 7, f. 8.

HAB. In pools, &c.

Ireland, Denmark, Sweden.

Plate XV., fig. 9. *a*, living fronds ; *b b*, empty fronds.

Penium phymatosporum. *Nordst. Desm. et Œdog., t.* XII., *f.* 1.

Small, about two and a quarter times as long as broad, subcylindrical, scarcely, or not, constricted in the middle; slightly attenuated from the middle to the rounded truncate apices; membrane very delicately longitudinally striate. Amylaceous nucleus single; zygospore rectangular or subquadrate, the obtuse angles protruding ; apices and sides concave, at the middle on each side a rounded tumour, and four tubercles in the centre ; membrane thick.

SIZE. Length 28-32 μ; diam. 14-17 μ; zygospore 36-42 × 40-36 μ (N.).

Joshua Journ. Bot. (1885), p. 35, t. 254, f. 11.

HAB. In pools.

Minety (Wilts) ; Italy.

Plate XVII., fig. 8. *a a*, living fronds ; *b*, empty frond ; *c*, zygospore.

C. *Empty frond smooth.*

Penium digitus. *Breb. in Ralfs. Desm., p.* 151, *t.* 25, *f.* 3.

Frond large, stout, smooth, three or four times as long as broad, elliptic-oblong, sides and ends broadly rounded ; endochrome in obscure and undulated fillets, interrupted only by the pale central transverse band, and leaving a clear space at the extremities.

SIZE. Diam. 60-80 μ (W.); length 300-400 μ ; diam. 60-82 μ (K.) ; length 360 μ ; diam. 100 μ (D.).

Brebisson Liste Desm. (1856), p. 145. Archer in Prit. Inf. (1861), p. 751. Delponte Desm. (1878), t. 15, f. 50-51 Cleve Sver. Desm. (1864), p. 493. Klebs. Desm. Pruss. (1879), p. 24. Lundell Desm. Suec. (1871), p. 84 ; Nordstedt Norges Desm. (1873), p. 43. Nordstedt Desm. Arct. (1875), p. 39. Petit Liste Desm. Paris (1877), p. 27. Wolle Desm. U.S. (1884), 34, t. 5, f. 1, 2, t. 53, f. 1. Kirch. Alg. Schles. (1878), p. 134. Grunow Desm. Austr. (1858), p. 501. Wood F. Wat. Algæ U.S. (1872), p. 107. Wittrock Scan. Desm. (1869), p. 20. Notaris Desm. Ital. (1867), p. 67, t. 8, f. 75. Rabh. Alg. Eur. (1868), p. 118. Jacobsen Desm. Denm. (1874), p. 165.

Closterium lamellosum, Breb. Alg. Fal. (1835), p. 59, t. 8.

Closterium digitus, Ehr. Abh. Berl. Ak. (1831), p. 68. Ehr. Inf. (1838). t. 6, f. 3. Hassall Fr. Alg. (1845), p. 376.

Penium oblongum, D. By. Conj. (1858), t. 7, G. fig. 1-2.

Pleurosicyos myriopodus, Corda Alm. Carls. (1835), t. 5, f. 68.

HAB. In pools, &c.

Widely distributed in England, Wales, Scotland ; France, Germany, Italy, Sweden, Russian Lapland, Norway, Denmark, Austria, United States.

Plate XVI., fig. 1. *a,* living frond ; *b,* empty frond.

Penium interruptum. *Breb. in Ralfs. Desm., p.* 151, *t.* 25, *f.* 4.

Frond large, stout, smooth, three or four times as long as broad, cylindrical, sides parallel, extremities conical and rounded at the ends, endochrome disposed in straight, strongly marked fillets, interrupted by three transverse pale bands, having a rounded, well-defined, clear space near the ends, in which are active granules.

SIZE. Diam. 38-44 μ (W.) ; diam. 37-44 μ (K.) ; length 280-320 μ ; diam. 50-64 μ (D.).

Breb. Liste Desm. (1856), p. 146. Archer in Prit. Inf. (1861), p. 751, t. 3, f. 45. Delponte Desm. (1878), t. 15, f. 1-9. Cleve Sver. Desm. (1864), p. 493. Lundell Desm. Suec. (1871), p. 84. Nordstedt Norges Desm. (1873), p. 43. Petit Liste Desm. Paris (1877), p. 28. Wood F. Wat. Algæ U.S. (1872), p. 108. Rabh. Alg. Eur. (1868), p. 119. Wolle Desm. U.S. (1884), p. 35, t.
(1878), p. 135.

Penium digitus β interruptum, Klebs. Desm. Pruss. (1879), p. 25.

Closterium interruptum, Jacobsen Desm. Denm. (1874), p. 167.

HAB. In ponds, pools, &c.

Sussex, Westmoreland, Cornwall, Wales ; France, Germany, Italy, Sweden, Norway, United States.

Plate XVI., fig. 2. *a b c,* living fronds.

Penium closterioides. *Ralfs. Desm., p.* 152, *t.* 34, *f.* 4.

Frond rather large, about six times as long as broad, smooth, fusiform or lanceolate, ends broadly rounded ; endochrome in distinct longitudinal fillets, interrupted only by the central transverse pale band with a single longitudinal series of large granules, and a rounded clear space close to the ends, in which are active granules. Zygospore globose, smooth.

SIZE. Diam. 40-44 μ (W.) ; diam. 40-44 μ ; zygospore 46-56 μ (K.).

Brebisson Liste Desm. (1856), p. 146. Archer in Prit. Inf. (1861), p. 751. Delponte Desm. (1878), t. 15, f. 19, 25 (in part). Notaris Desm. Ital. (1867), t. 8, f. 76. Cleve Sver. Desm. (1864), p. 493. Lundell Desm. Suec. (1871), p. 84.

Klebs. Desm. Pruss. (1879), p. 24. Nordstedt Norges Desm. (1873), p. 43. Petit Liste Desm. Paris (1877), p. 28. Wood F. Wat. Algæ U.S. (1872), p. 109. Rabh. Alg. Eur. (1868), p. 121. Wolle Desm. U.S. (1884), p. 35, t. 5, f. 18. Kirch. Alg. Schles. (1878), p. 135.

Closterium lens, var. *intermedia*, Jacobsen Desm. Denm. (1874), p. 167.

HAB. In ponds.

Sussex, Surrey, Hants, Cornwall, Wales, Ireland ; France, Germany, Italy, Sweden, Norway, United States.

Plate XVI., fig. 3. *a*, living frond ; *b b*, empty fronds.

Penium Nägelii. *(Bréb.) Pritch. Infus., p.* 751.

Frond large, stout, smooth, about four times longer than broad, oblong, not contracted at the middle, gradually tapering to each extremity, sides nearly straight, ends broadly truncate, endochrome arranged in interrupted divided planes radiating from the central axis, in front view being indented somewhat in a pinnatified manner, the rays touching the cell wall, sometimes divided, and somewhat dilated thereat, in transverse view radiate.

SIZE. Length 160 μ ; diam. 34 μ.

Nordstedt Norges Desm. (1873), p. 43. Petit Liste Desm. Paris (1877), p. 27. Rabh. Alg. Eur. (1868), p. 119.

Closterium (Netrium) digitus, Nag. Einz. Alg. (p. 108), t. 6, D.

HAB. In ponds, &c.

Ireland ; France, Germany, Norway.

Plate XVI., fig. 4. *a a*, living frond ; *b*, empty frond ; *c*, transverse section.

Penium navicula. *Bréb. Liste Desm., t. 2, f.* 37.

Frond minute, about three or four times as long as broad, smooth, fusiform, ends bluntly pointed ; endochrome sometimes scattered, interrupted only by the transverse central pale band, with one or two large granules in each half, and a rounded clear space at the end, in which are active granules. Zygospore subquadrate, compressed, with rather acute angles.

SIZE. Diam. 12-17 μ (W.) ; length 43-72 μ ; diam. 12-17 μ ; zygospore 33-38 × 38-43 μ (K.).

Archer in Prit. Inf. (1861), p. 751. Lundell Desm. Suec. (1871), p. 84. Nordstedt Norges Desm. (1873), p. 43. Notaris. Desm. Ital. (1867), p. 68, t. 8, f. 77. Rabh. Alg. Eur. (1868), p. 121. Wolle Desm. U.S. (1884), p. 36, t. 5, f. 16.

Closterium lens, var. *minor*, Jacobsen Desm. Denm. 1874), p. 168.

Penium Berginii, Archer Nat. Hist. Rev.

Penium closterioides b navicula, Klebs. Desm. Pruss. (1879), p. 24.

HAB. In ponds, &c.

Ireland, Cornwall; France, Germany, Sweden, Norway, Italy, United States.

Plate XVI., fig. 5. *aa*, living fronds; *b b*, empty fronds.

Penium Brebissonii. *Ralfs. Desm.*, 153, *t.* 25, *f.* 6.

Frond smooth, cylindrical with rounded ends, transverse central band inconspicuous, zygospore at first quadrate, finally orbicular, conjugating fronds persistent.

SIZE. Diam. 16-17 μ (W.); diam. 15-30 μ (K.).

Wood F. W. Algæ U.S. (1872), p. 108. Brebisson Liste Desm. (1856), p. 147. Rabh. Alg. Eur. (1868), p. 120. De Bary Conjug. (1858), p. 74, t. 7, E. Lundell Desm. Suec. (1871), p. 83. Nordstedt Norges Desm. (1873), p. 43. Nordstedt Desm. Arct. (1875), 14, 37, 39. Petit Liste Desm. Paris (1877), p. 27. Wille Nov. Sem. (1879) [illegible] Jacobsen Desm. Denm. ([illegible] Spitz. (1872), p. 25. W [illegible] f. 7, 8. Kirch. Alg. Schles. (1878), p. 136.

Penium Brebissonii a. typicum. Klebs. Desm. Pruss. (1879), p. 23.

Palmella cylindrospora, Brebisson Alg. Fal. (1835), p. 64.

Cylindrocystis Brebissonii, Meneg. Nost. (1841), p. 89, t. 12, f. 3.

HAB. In pools, &c.

Widely distributed in Great Britain; Sweden, Germany, France, Spitzbergen, Nova Zembla, Russian Lapland, Norway, United States, New Zealand.

var. C. **Jenneri.** (*Ralfs.*) *Kirch. Alg. Schles.*, p. 136.

Zygospore orbicular, conjugating fronds deciduous.

SIZE. Length 40 μ; diam. 14-18 μ (K.).

Brebisson Liste Desm. (1856), p. 147. Wood F. W. Algæ (1872), p. 108. Rabh. Alg. Eur. (1868), p. 120. Wolle Desm. U.S., p. 36.

Penium Jenneri, Ralfs. Desm. (1848), p. 153, t. 33, f. 2.

Plate XVII., fig. 3. *a b*, living fronds; *c*, empty frond; *d*, young zygospore; *e*, ripe zygospore.

Penium truncatum. *Breb. in Ralfs. Desm.*, p. 152, *t.* 52, *f.* 5.

Frond minute, two to four times as long as broad, cylindrical, smooth, ends truncate. Zygospore orbicular, smooth, placed between the dehiscing deciduous empty fronds.

SIZE. Diam. 11-12 μ (W.); diam. 11-12 μ (K.); length 21-28 μ; diam. 10 μ (D.).

Breb. Liste Desm. (1856), p. 146. Archer in Prit. Inf. (1861), p. 751. Delponte Desm. (1878), t. xv., f. 37-39. Grunow Desm. Austr. (1858), p. 501. Notaris Desm. Ital. (1867), p. 69, t. 8, f. 78. Rabh. Alg. Eur. (1868), p. 121. Wolle Desm. U.S. (1884), p. 35, t. 5, f. 9, 10, 21, 22. Kirch. Alg. Schles. (1878), p. 136.

Pleurotænium truncatum, Cleve Sver. Desm. (1864), p. 494.

Cylindrocystis truncata, Breb. *fide* Ralfs. (1847).

HAB. In pools.

Wales, Ireland, Cornwall; France, Germany, Sweden, Austria, Italy, United States.

Plate XVII., fig. 4. *a a*, living fronds; *b*, empty frond; *c*, zygospore.

Penium didymocarpum. *Lundell Desm. Suec.*, p. 85, *t.* 5, *f.* 9.

Minute, sub-cylindrical, not constricted in the middle, scarcely attenuated towards the rounded apices, membrane smooth. Zygospore geminate, compressed, subquadrate, rounded at the angles.

SIZE. Length 33-38 μ; diam. 14 μ; zygospore 34-38 × 26-30 μ.

Archer Micr. Journ. (1873), xiii., p. 213. Jacobsen Desm. Denm. (1874), p. 164.

Schizospora minor, Reinsch. Alg. et Fung. (1874), t. 17, f. 2.

HAB. In ponds, &c.

Cornwall, Ireland, Denmark.

Plate XVII., fig. 6. *a*, living frond; *b*, empty frond; *c*, zygospore.

Penium crassiusculum. *De Bary Conjug.* (1858), p. 73, *t.* 5, *f.* 5-7.

Frond short, cylindrical, three to four times as long as broad. Cell-membrane wholly smooth.

SIZE. Length 70 μ; diam. 20 μ.

HAB. In rock pools, &c.

Craigendennie Rocks (Scotland), Germany.

Plate XVII., fig. 7. *a b*, living fronds; *c*, empty frond, after De Bary.

Penium Mooreanum. *Archer Micr. Journ.* (1864), *p.* 179, *t.* 6, *f.* 34-44.

Frond very minute, about one-third longer than broad, sides somewhat barrel-shaped, ends truncate-rotund, no clear space with moving granules at the extremities; zygospore quadrangular, oblong, compressed, angles mamillate, extremities nipple-like.

SIZE. 19 × 12 μ; zygospore 18 × 12 × 14 μ (A.).

Rabh. Alg. Eur. (1868), p. 123.

Penium pusillum, Delponte Desm. (1878), p. 89, t. 15, f. 34-36. (?)

HAB. In bogs.

Ireland (Featherbed Bog and Lough Bray); Italy (?).

Plate XVII., fig. 5. *a*, living fronds; *b*, the same magnified 1,000 diam.; *c d*, zygospores; *e*, young zygospore, after Archer.

Penium spinospermum. *Josh. Journ. Bot.* (1885), 35, *t.* 254, *f.* 10.

Small, about two and a quarter times longer than wide, subcylindrical, with a very slight median constriction; apices round, very slightly attenuated; membrane smooth; zygospores in young state globose and smooth, when mature thickly covered with obtuse projections.

SIZE. Length 33 μ; breadth 25 μ; zygospore 23 μ; length of processes 7½ μ.

HAB. In bog pools.

Derrystrasna Bog, Armagh.

Plate XVII., fig. 9. *a*, living frond; *b*, empty frond; *c d*, zygospores.

Penium minutissimum. *Nordst. Norges Desm.* (1873), *fig.* 21.

Very minute, about 1½ times longer than broad, subelliptical, a little or scarcely constricted in the middle, from thence to the broadly rounded apices very slightly but gradually attenuated; seen vertically, perfectly circular. Membrane smooth, yellowish; amylaceous granule single. (?) Zygospore subquadrate, angles rounded, a little prominent; seen vertically and laterally, broadly elliptical. Membrane yellowish.

SIZE. Length 12-16 μ; diam. 9-10 μ. Zygospore 16 × 14 μ (N.).

HAB. In pools.

Scotland, Norway.

Plate XVII., fig. 10. *a*, living fronds; *b*, the same magnified more highly; *c*, empty frond; *d e*, zygospores; *b* to *e*, magnified 1,000 diam.

Penium lagenarioides *Roy. Micr. Journ.* 1884, *p.* 197, *t.* 5, *f.* 6, *Joshua Journ. Bot.* (1883), *p.* 292.

SIZE. 95 × 45 μ.

(Description imperfect.)

HAB. In pools.

Isle of Arran, Deeside, Windermere.

Penium truncatum. *Breb. in Ralfs. Desm.*, p. 152, *t.* 52, *f.* 5.

Frond minute, two to four times as long as broad, cylindrical, smooth, ends truncate. Zygospore orbicular, smooth, placed between the dehiscing deciduous empty fronds.

SIZE. Diam. 11-12 μ (W.); diam. 11-12 μ (K.); length 21-28 μ; diam. 10 μ (D.).

Breb. Liste Desm. (1856), p. 146. Archer in Prit. Inf. (1861), p. 751. Delponte Desm. (1878), t. xv., f. 37-39. Grunow Desm. Austr. (1858), p. 501. Notaris Desm. Ital. (1867), p. 69, t. 8, f. 78. Rabh. Alg. Eur. (1868), p. 121. Wolle Desm. U.S. (1884), p. 35, t. 5, f. 9, 10, 21, 22. Kirch. Alg. Schles. (1878), p. 136.

Pleurotænium truncatum, Cleve Sver. Desm. (1864), p. 494.

Cylindrocystis truncata, Breb. *fide* Ralfs. (1847).

HAB. In pools.

Wales, Ireland, Cornwall; France, Germany, Sweden, Austria, Italy, United States.

Plate XVII., fig. 4. *a a*, living fronds; *b*, empty frond; *c*, zygospore.

Penium didymocarpum. *Lundell Desm. Suec.*, p. 85, *t.* 5, *f.* 9.

Minute, sub-cylindrical, not constricted in the middle, scarcely attenuated towards the rounded apices, membrane smooth. Zygospore geminate, compressed, subquadrate, rounded at the angles.

SIZE. Length 33-38 μ; diam. 14 μ; zygospore 34-38 × 26-30 μ.

Archer Micr. Journ. (1873), xiii., p. 213. Jacobsen Desm. Denm. (1874), p. 164.

Schizospora minor, Reinsch. Alg. et Fung. (1874), t. 17, f. 2.

HAB. In ponds, &c.

Cornwall, Ireland, Denmark.

Plate XVII., fig. 6. *a*, living frond; *b*, empty frond; *c*, zygospore.

Penium crassiusculum. *De Bary Conjug.* (1858), p. 73, *t.* 5, *f.* 5-7.

Frond short, cylindrical, three to four times as long as broad. Cell-membrane wholly smooth.

SIZE. Length 70 μ; diam. 20 μ.

HAB. In rock pools, &c.

Craigendennie Rocks (Scotland), Germany.

Plate XVII., fig. 7. *a b*, living fronds; *c*, empty frond, after De Bary.

Penium Mooreanum. *Archer Micr. Journ.* (1864), *p.* 179, *t.* 6, *f.* 34-44.

Frond very minute, about one-third longer than broad, sides somewhat barrel-shaped, ends truncate-rotund, no clear space with moving granules at the extremities ; zygospore quadrangular, oblong, compressed, angles mamillate, extremities nipple-like.

SIZE. 19 × 12 μ ; zygospore 18 × 12 × 14 μ (A.).

Rabh. Alg. Eur. (1868), p. 123.

Penium pusillum, Delponte Desm. (1878), p. 89, t. 15, f. 34-36. (?)

HAB. In bogs.

Ireland (Featherbed Bog and Lough Bray) ; Italy (?).

Plate XVII., fig. 5. *a,* living fronds ; *b,* the same magnified 1,000 diam. ; *c d,* zygospores ; *e,* young zygospore, after Archer.

Penium spinospermum. *Josh. Journ. Bot.* (1885), 35, *t.* 254, *f.* 10.

Small, about two and a quarter times longer than wide, subcylindrical, with a very slight median constriction ; apices round, very slightly attenuated ; membrane smooth ; zygospores in young state globose and smooth, when mature thickly covered with obtuse projections.

SIZE. Length 33 μ ; breadth 25 μ ; zygospore 23 μ ; length of processes 7½ μ.

HAB. In bog pools.

Derrystrasna Bog, Armagh.

Plate XVII., fig. 9. *a,* living frond ; *b,* empty frond ; *c d,* zygospores.

Penium minutissimum. *Nordst. Norges Desm.* (1873), *fig.* 21.

Very minute, about 1½ times longer than broad, subelliptical, a little or scarcely constricted in the middle, from thence to the broadly rounded apices very slightly but gradually attenuated ; seen vertically, perfectly circular. Membrane smooth, yellowish ; amylaceous granule single. (?) Zygospore subquadrate, angles rounded, a little prominent ; seen vertically and laterally, broadly elliptical. Membrane yellowish.

SIZE. Length 12-16 μ ; diam. 9-10 μ. Zygospore 16 × 14 μ (N.).

HAB. In pools.

Scotland, Norway.

Plate XVII., fig. 10. *a,* living fronds ; *b,* the same magnified more highly ; *c,* empty frond ; *d e,* zygospores ; *b* to *e,* magnified 1,000 diam.

Penium lagenarioides *Roy. Micr. Journ.* 1884, *p.* 197, *t.* 5, *f.* 6, *Joshua Journ. Bot.* (1883), *p.* 292.

SIZE. 95 × 45 μ.

(Description imperfect.)

HAB. In pools.

Isle of Arran, Deeside, Windermere.

Mesotænium Greyi. *Turner Naturalist* (1886), *p.* 34, *t.* 1, *f.* 1.

Frond cylindrical, smooth, straight, rarely curved, elongate, no apparent constriction, not tapering at all towards the ends, which are more or less broadly rounded.

SIZE. Length 76-104 μ; diam. 20-23 μ (T.).

HAB. In rock pools.

Yorkshire.

Plate XVIII., fig. 6, *a*, living frond; *b b*, empty fronds; after Turner.

GENUS 12.. **TETMEMORUS.** *Ralfs.* (1845).

Frond elongated, straight, cylindrical, or fusiform, constricted at the middle; segments more or less tapering, not inflated at the base; ends with an acute incision, the subdivisions rounded, otherwise quite entire.

Tetmemorus Brebissonii. *Ralfs. Ann. Nat. Hist.* (1844), xiv, *t.* 8, *f.* 1.

Frond in front view with parallel sides, in lateral view fusiform; ends without any projecting processes; puncta in longitudinal lines.

SIZE. Diam. 18-20 μ (W.); diam. 17-30 μ (K.); length 194 μ; diam. 28 μ (D.).

Ralfs. Desm. (1848), p. 145, t. 24, f. 1. Archer in Prit. Inf. (1861), p. 746, t. 2, f. 12-13. Delponte Desm. (1878), t. 15, f. 53-54. Cleve Sver. Desm. (1864), p. 492. Lundell Desm. Suec. (1871), p. 76. Nordstedt Norges Desm. (1873), p. 39. Petit Liste Desm. Paris (1877), p. 29. Grunow Desm. Austr. (1858), p. 501. Kirch Alg. Schles. (1878), p. 145. Wittrock Scan. Desm. (1869), p. 19. Brebisson Liste Desm. (1856), p. 145. Notaris Desm. Ital. (1867), p. 58, t. 6, f. 59. Rabh. Alg. Eur. (1868), p. 139. Jacobsen Desm. Denm. (1874), p. 179. Wolle Desm. U.S. (1884), p. 91, t. 20, f. 1-2, t. 50, f. 36.

Closterium Brebissonii, Meneg. Syn. Desm. (1840), p. 236.

Closterium monile, Kntz. Phy. Germ. (1845), p. 132.

Penium striato-punctatum, Kntz. Spec. Alg. (1849), p. 168.

HAB. In ponds and pools.

Sussex, Kent, Surrey, Hants, Cornwall, Westmoreland, Wales, Scotland; France, Germany, Norway, Sweden, Denmark, Austria, Italy, United States.

Plate XVIII., fig. 7. *a*, *b*, living fronds; *c*, empty frond.

var. *β*. **turgidum,** *Ralfs. Desm.* (1848), *p.* 145, *t.* 24, *f.* 1, *d e.*
Larger, stouter, constriction deeper.

var. *γ*. *(De Bary) Archer in Pritch. Infus.* (1861), *p.* 746.
Smaller than either of the above, otherwise externally similar, endochrome in longitudinal fillets.

Tetmemorus granulatus. *Ralfs. Ann. Nat. Hist.* (1844), XIV., *t.* 8, *f.* 2.

Frond fusiform, both in front and lateral views, ending in a colourless lip-like projection. Empty frond minutely punctate. Zygospore orbicular.

SIZE. Diam. 38-50 μ (W.); diam. 39-56 μ (K.); length 122; diam. 43 μ (D.).

Ralfs. Desm. (1848), p. 147, t. 24, f. 2. Archer in Prit. Inf. (1861), p. 746. Hassall Fr. Alg. (1845), p. 378, t. 89, f. 6. Delponte Desm. (1878), p. 138, t. 15, f. 55-56. Notaris Desm. Ital. (1867), t. 6. Cleve Sver. Desm. (1864), p. 492. Lundell Desm. Suec. (1871), p. 76. Nordstedt Norges Desm. (1873), p. 39. Nordstedt Desm. Arct. (1875), p. 40. Wood F. Water Algæ U.S. (1872), p. 117. Wolle Desm. U.S. (1884), p. 91, t. 50, f. 33-34. Petit Liste Desm. Paris (1877), p. 29. Wittrock Scan. Desm. (1869), p. 19. Brebisson Liste Desm. (1856), p. 145. Notaris Desm. Ital. (1867), p. 58, t. 6, f. 58. Rabh. Alg. Eur. (1868), p. 140. Jacobsen Desm. Denm. (1874), p. 180. Kirch. Alg. Schles. (1878), p. 145.

Closterium granulatum, Breb. Meneg. Syn. Desm. (1840), p. 236.

Penium (Tetmemorus) granulatus, Kutz. Spec. Alg. (1849), p. 167.

HAB. In ponds.

Sussex, Surrey, Hants, Kent, Gloucester, Lancashire, Westmoreland, Cornwall, Wales, Scotland, Ireland; France, Germany, Sweden, Norway, Denmark, Italy, Russian Lapland, United States.

Plate XVIII., fig. 8. *a*, *b*, living fronds; *c*, empty frond.
Plate XIX., fig. 1. Zygospore.

Tetmemorus lævis. *Ralfs. Desm.* (1848), *p.* 146, *t.* 24, *f.* 3.

Frond in front view somewhat tapering, with truncate ends; lateral view fusiform, empty frond without puncta, or very indistinct. Zygospore at first quadrate, then oval, compressed.

SIZE. Diam. 20-22 μ (W.); diam. 20-25 μ (K.).

Brebisson Liste Desm. (1856), p. 145. Archer in Prit. Inf. (1861), p. 746. Nordstedt Norges Desm. (1873), p. 39. Nordstedt Desm. Arct. (1875), p. 40. Grunow Desm. Austr.

(1858), p. 501. Wood F. Water Algæ U.S. (1872), p. 118. Notaris Desm. Ital. (1867), p. 59, t. 6, f. 60. Rabh. Alg. Eur. (1868), p. 140. Wille Nov. Sem. (1879), p. 58. Wolle Desm. U.S. (1884), p. 91, t. 50, f. 35, t. 20, f. 3. Kirch. Alg. Schles. (1878), p. 145.

Closterium læve, Kutz. Phyc. Germ. (1845), p. 132.

Penium (Tetmemorus) Brebissonii, Kutz. Spec. Alg. (1849), p. 167.

Tetmemorus granulatus, Ralfs. Ann. Nat. Hist. (1844), xiv., t. 8, f. 2, *d*, *e*, *f*, *g*.

Hab. In pools.

Sussex, Norfolk, Wales, Scotland; France, Germany, Russian Lapland, Nova Zembla, Norway, Austria, Italy, United States.

Plate XIX., fig. 2. *a a*, *c c*, living fronds; *b d*, empty fronds; *e f*, zygospores.

Tetmemorus penioides. *Bennett Micr. Journ., Vol.* VI. (1886), *p.* 13, *t.* 2, *f.* 26.

Frond about the size of *T. granulatus*, broad, linear-elliptic, distinctly notched at each extremity, but without any lip-like process. Margin continuous, with scarcely any constriction. Cell wall smooth (not punctate or granulate).

Size. Length 190 μ; diam. 47 μ (B.).

Hab. Amongst *Sphagnum*.

Lancashire.

Plate XIX., fig. 9. *Plate XXVI., fig.* 2. Living and empty fronds, after Bennett.

Genus 13. **SPIROTÆNIA.** *Breb.* (1846).

Frond elongate, straight, cylindrical, or fusiform, entire, not constricted at the middle, ends rounded or acute; endochrome spiral.

For details of fructification see Archer in Micro. Journ. (1867), p. 186.

* *Spiral single.*

Spirotænia condensata. *Breb. in Ralfs. Desm.* (1848), *p.* 179, *t.* 34, *f.* 1.

Frond cylindrical, five to ten times as long as broad, ends rounded; endochrome a single broad, closely wound spiral band, its revolutions numerous. Zygospore orbicular, areolate.

Size. Diam. 18-25 μ (W.); diam. 18-25 μ (K.); length 180 μ; diam. 25 μ (D.).

Breb. Liste Desm. (1856), p. 157. Archer in Prit. Inf. (1861), p. 751, t. 2, f. 4. Delponte Desm. (1878), t. 20, f. 26.

Notaris Desm. Ital. (1867), t. 9, f. 82. Nordstedt Desm. Arct. (1875), p. 15. Cleve Sver. Desm. (1864), p. 492. Lundell Desm. Suec. (1871), p. 91. Nordstedt Norges Desm. (1873), p. 47. Kirch. Alg. Schles. (1878), p. 136. Petit Liste Desm. Paris (1877), p. 29. Wood F. Water Algæ U.S. (1872), p. 122. Wittrock Scan. Desm. (1869), p. 19. Notaris Desm. Ital. (1867), p. 71, t. 9, f. 82. Rabh. Alg. Eur. (1868), p. 146. Wille Nov. Sem. (1879), p. 58. Jacobsen Desm. Denm. (1874), p. 181. Wolle Desm. U.S. (1884), p. 33, t. 3, f. 21-22.

HAB. In boggy pools.

Sussex, Kent, Gloucester, Westmoreland, Cornwall, Norfolk, Wales, Scotland; France, Germany, Sweden, Norway, Spitzbergen, Nova Zembla, Denmark, Italy, United States.

Plate XIX., fig. 3. *a,* living frond; *b,* zygospore.

Spirotænia truncata. *Archer Micr. Journ.* (1862), II., *p.* 253, *t.* 12, *f.* 28-31.

Frond minute, cylindrical, five to eight times longer than broad, tapering near the truncate ends; endochrome a single, rather closely wound, spiral band, leaving a minute clear space at each end, often containing one or more free granules.

SIZE. Length 50 μ; diam. 7 μ (A.).

Rabh. Alg. Eur. (1868), p. 147. Wille Nov. Sem. (1879), p. 58. Jacobsen Desm. Denm. (1872), p. 181.

HAB. In small pools.

Ireland; Denmark, Nova Zembla.

Plate XIX., fig. 4. *a b,* living fronds; *c,* further magnified; *d e,* zygospores.

Spirotænia parvula. *Archer Micr. Journ.* (1862), II., *p.* 254, *t.* 12, *f.* 32-43.

Frond very minute, five to eight times longer than broad, slender, fusiform, ends subacute; endochrome obliquely parietal, scarcely spiral.

SIZE. Length 30 μ; diam. 8 μ (L.); length 17-35 μ; diam. $3\frac{1}{2}$-$4\frac{1}{2}$ μ (A.).

Lundell Desm. Suec. (1871), p. 91. Rabh. Alg. Eur. (1868), p. 147.

HAB. In sphagnum pools.

Ireland, Sweden.

Plate XIX., fig. 5. *a,* living fronds.

ipirotænia minuta. *Thuret in Breb. Liste* (1856), *p.* 157, *t.* 1, *f.* 30.

Frond fusiform, five or six times as long as broad, ends acute; ndochrome a single, rather narrow spiral band, its revolutions ew.

SIZE. Diam. 8-10 μ (K.).

Archer Micr. Journ. (1868), viii., pp. 68. Cleve Sver. Desm. (1864), p. 492. Lundell Desm. Suec. (1871), p. 91. Rabh. Alg. Eur. (1868), p. 147. Kirch. Alg. Schles. (1878), p. 136.

Spirotænia erythrocephala, Braun. Archer Prit. Inf. 1861), p. 751.

(Carrig Mountain) Ireland; Sweden, France.

Plate XIX., fig. 7. *a b*, living fronds.

Spirotænia tenerrima. *Archer Micr. Journ.* (1870), *p.* 203.

Exceedingly slender, cells somewhat curved or arched, slightly tapering, ends truncate, endochrome forming a single spiral reaching from end to end of the cavity. Cell division transverse.

SIZE. As regards width this is the most minute known, though *S. parvula* is shorter. It agrees pretty nearly with *Rhaphidium falcatum* in size.—*(Archer.)*

HAB. In pools.

Ireland.

Spirotænia bryophila. *Breb. Rabh. Alg. Eur., p.* 146.

Small, growing on mosses, involved in gelatin, oblong-cylindrical, straight or somewhat curved, twice or three times longer than broad, rounded at each extremity, with a single chlorophyll band, making one or one and a half turns.

SIZE. Diam. 8 μ (W.).

Wolle Desm. U.S. (1884), p. 33, t. 3, f. 20.

Endospira bryophila, Breb. in Desm. Crypt. de Fr. (1850), No. 1654.

Palmoglœa endospora, Kutz. Tab. Phy. i., p. 19, t. 24, f. 6. Spec. Alg., p. 229.

Spirotænia muscicola, De Bary Conj. (1858), p. 75, t. vii, f. F.

HAB. On mosses, &c.

France, Germany, Sweden, Switzerland, United States.

Plate XIX., fig. 8. *a*, cell family; *b*, mature living cell.

⁂ *Spiral bands numerous.*

Spirotænia obscura. *Ralfs. Desm.* (1848), *p.* 179, *t.* 34, *f.* 2.

Frond cylindrical, or fusiform, five to eight times longer than broad, extremities rounded, ends blunt; endochrome in several slender spiral bands, their revolutions two or three, sometimes scattered, having a clear space at each extremity in which there is sometimes a free granule.

SIZE. Diam. 8-15 μ (W.); length 160 μ; diam. 30 μ (K.) (L.); length 76 μ; diam. 15 μ (*Minor*); length 136-226 μ; diam. 28-— μ (D.).

Brebisson Liste Des. (1856), p. 157. Archer in Prit. Inf. (1861), p. 752. Delponte Desm. (1878), t. 20, f. 24-25. Nordstedt Desm. Arct. (1875), p. 16. Cleve Sver. Desm. (1864), p. 492. Lundell Desm. Suec. (1871), p. 91. Nordstedt Norges Desm. (1873), p. 47. Rabh. Alg. Eur. (1868), p. 147. Wille Nov. Sem. (1879), p. 58. Wolle Desm. U.S. (1884), p. 33, t. 3, f. 16-19. Kirch. Alg. Schles. (1878), p. 136.

HAB. In bogs.

Kent, Cornwall, Wales, Ireland; France, Italy, Spitzbergen, Sweden, Nova Zembla.

Plate XIX., fig. 6. *a b*, living fronds.

Sect. B. COSMOSPORÆ. Zygospores normally warted, spinulose, or ornate.

GENUS 14. MICRASTERIAS. *Agardh.* (1827).

Frond mostly lenticular, as long as, or slightly longer, than broad, deeply constricted into two-lobed segments; segments usually semi-orbicular, 5 or sometimes 3-lobed; lobes incised or divided, mostly radiant, their ultimate subdivisions spreading, dentate or minutely spined, or rarely only sinuate at the outer margin; central constriction usually linear.

Sub-Gen. I. TETRACHASTRUM. *Dixon.*

Lateral lobes broadest at their base, and attenuated outwards.

Micrasterias (Tetrachastrum) mucronata. (*Dixon*), *Rabh. Alg. Eur.* (1868), *p.* 187.

Frond longer than broad, sub-elliptic; lateral lobes very broad, straight on the margin, forming the base of the segment, turgid on the upper margin, their extremities rounded, furnished on the margin with one, two, or three minute micro-like spines, one always at the extremity or basal angle of the segment, others, when present, irregularly placed on the upper margin; terminal lobe short, very broad, its lateral projections short, stout, quickly tapering, somewhat incurved at extremities, which are mucronate; ends rounded, with a very shallow inconspicuous central concavity; transverse view broadly elliptic, empty frond punctate.

SIZE. Diam. 96-110μ (K.).

Nordstedt Norges Desm. (1873), p. 6. Kirchner Alg. Schles. (1878), p. 163.

Tetrachastrum mucronatum, Dixon. Archer in Prit. Inf. (1861), p. 725.

Hab. In pools.

Ireland, Wales; Germany, Norway.

Plate XX., fig. 1. *a*, living frond; *b*, empty frond; *c*, side view; *d*, end view.

Micrasterias (Tetrachastrum) oscitans. *(Hass.) Ralfs. Desm.* (1848), *p.* 76, *t.* 10, *f.* 2.

Frond about as broad as long, pinnatifid, lateral lobes separated from the terminal by a rounded sinus, horizontal, conical, their extremities bidentate; end lobe short, broad, its lateral projections short, conical, usually bidentate, narrower and shorter than the lateral lobes; ends convex at the centre, transverse view fusiform; empty frond punctate.

Size. 100 × 120 μ (R.); diam. 150-160 μ (W.).

Rabh. Alg. Eur. (1868), p. 169. Jacobsen Desm. Denm. (1874), p. 185 (partly). Wolle Desm. U.S. (1884), p. 116, t. 33, f. 3, 4. Brebisson Liste Desm. (1856), p. 121.

Holocystis oscitans, Hassall Fr. Alg. (1845), t. 90, f. 4.

Tetrachastrum oscitans, Dixon. Archer Prit. Inf. (1861), 725, t. 2, f. 28, 29.

Hab. In ponds.

Sussex, Westmoreland, Wales, Scotland; France, Denmark, United States.

Plate XX., fig. 2. *a*, living frond; *b*, empty frond; *c*, transverse view.

Micrasterias (Tetrachastrum) pinnatifidum. *(Kutz.) Ralfs. Desm.* (1848), *p.* 77, *t.* 11, *f.* 2.

Frond rather broader than long, plane, pinnatifid, lateral lobes separated from the terminal by an equal subacute incision, triangular, subconical, horizontal, their extremities bidentate; end lobe short, its lateral projections transverse, short, bidentate at the extremities, ends straight.

Size. 55 × 62 μ (R.); diam. 83-110 μ (W.).

Wittrock Scan. Desm. (1869), p. 10. Brebisson Liste (1856), p. 121. Wolle Desm. U.S (1884), p. 116, t. 37, f. 7, 8, 9. Nordstedt Norges Desm. (1873), p. 6. Cleve Sver. Desm. (1864), p. 487. Lundell Desm. Suec. (1871), p. 15.

Euastrum pinnatifidum Kutz. Phy. Germ. (1845), p. 134.

Tetrachastrum pinnatifidum, Dixon. Archer Prit. Inf. (1861), p. 725.

Micrasterias oscitans, var. b. *pinnatifida*, Rabh. Alg. Eur. (1868), p. 189. Jacobsen Desm. Denm. (1874), p. 185.

Hab. In pools.

Britain ; France, Germany, Sweden, United States.

Plate XX, fig. 3. *a*, living frond ; *b*, empty frond.

Sub-Genus II. EU-MICRASTERIAS.

Lateral lobes narrower at the base, and expanded onwards.

Micrasterias furcata. *Ag. Bot. Zeit.* (1827).

Frond smooth, segments sub-five-lobed ; basal and middle lobes bifid, their subdivisions slender, linear, divergent, and forked at the apex ; bifurcation usually incurved ; end lobe exserted, with a rounded sinus between the considerably produced divergent extensions from the angles, which are ultimately forked, their bifurcations incurved.

Size. Length 140-220 ; diam. 113-205 μ (K.) ; length 144 μ ; diam. 166 μ (T.) ; diam. 150-180
μ ; diam. 162 μ (R.

Kutz. Syn. (1833
f. 2. Archer in Pri
(1864), p. 487. Lu
Desm. U.S. (1884),
Paris (1877), p. 31.
144. Wittrock Scan. Desm. (1869), p. 9. Kirchner Alg. Schles. (1878), 7. 162.

Micrasterias crux-melitensis, var. *b. furcata*. Rabh. Alg. Eur. (1868), p. 190.

Micrasterias radiata, Hass. Fr. Alg. (1845), p. 386.

Micrasterias melitensis, Ralfs. Ann. N. H. (1844), xiv., t. 6, f. 2.

Micrasterias melitensis, *β. gracilis*, Kutz.

Hab. In pools and streams.

Wales, Ireland, Westmoreland ; France, Germany, Sweden, United States.

Plate XXI., fig. 1. *a*, living frond ; *b*, empty frond.

Micrasterias crux-melitensis. (*Ehr.*) *Meneg. Syn. Desm.* (1840), p. 216.

Frond smooth, segments sub-five-lobed ; basal and middle lobes bifid, subdivisions short, stout, and bidentate at the apex ; end lobe exserted, with a rounded sinus between the produced divergent extensions from the angles, which are ultimately bidentate.

Size. 107-130 × 98-119 μ (K.); diam. 100-125 μ (W.); length 129 μ; diam. 124 μ (D.); length 122 μ; diam. 114 μ (R.).

Ralfs. Desm. (1848), p. 73, t. 9, f. 3. Archer in Prit. Inf. (1861), p. 726, t. 1, f. 22. Delponte Desm. (1876), p. 87, t. 4, f. 7-13. Cleve Sver. Desm. (1864), pp. 487. Lundell Desm. Suec. (1871), p. 14. Wolle Desm. U.S. (1884), p. 111, t. 35, f. 3. Brebisson Liste Desm. (1856), p. 120. Petit Liste Desm. Paris (1877), p. 31. Wittrock Scan. Desm. (1869), p. 9. Rabh. Alg. Eur. (1868), p. 190, partly. Jacobsen Desm. Denm. (1874), p. 188. Kirchner Alg. Schles. (1878), p. 161.

Euastrum crux-melitensis, Ehr. Abh. Berl. Ak. (1831), p. 82. Inf., p. 162, t. 12, f. 3.

Hab. In pools.

Cheshire, Westmoreland, Sussex, Norfolk, Wales; France, Germany, Sweden, Denmark, Italy, United States.

Plate XXI., fig. 2. *a,* living frond; *b,* empty fronds; *c,* transverse view.

Micrasterias Americana. (*Ehr.*) *Ralfs. Desm.* (1848), p. xix.

Frond angular elliptic, more or less punctate; segments three-lobed; lateral lobes broad, cuneate, their margins concave, inciso-serrate; end lobe broad, cuneate, and exserted, bipartite at the angles, the subdivisions narrow, and minutely dentate at the extremities; end concave.

Size. Length 115-153; diam. 92-132 μ (K.); diam, 100-115 μ (W.); length 122 μ; diam 100 μ (R.).

Rabh. Alg. Eur. (1868), p. 189. Kirch. Alg. Schles. (1878), p. 161. Wood F. W. Algæ (1872), p. 143. Wolle Desm. U.S. (1884), p. 112, t. 32, f. 2. Archer in Prit. Inf. (1861), p. 726, t. ii., f. 44. Cleve Sver. Desm. (1864), p. 487. Lundell Desm. Suec. (1871), p. 15. Nordstedt Norges Desm. (1873), p. 6.

Euástrum Americanum, Ehr. Micr. Leb. (1843), t. 4, f. 15.
Micrasterias morsa, Ralfs. Desm. (1848), p. 74, t. 10, f. 1.

Hab. In boggy pools.

Sussex, Wales; France, Germany, Sweden, Norway, United States.

Plate XXX., fig. 1. *a c,* living fronds; *b,* empty frond.

Micrasterias denticulata. *Breb. Alg. Fal.* (1835), *t.* 8.

Frond orbicular, smooth; segments five-lobed; basal and middle lobes twice dichotomous, ultimate subdivisions truncato-emarginate with rounded angles; end lobe simply thrice emarginate. Zygospore orbicular, beset with scattered stout elongate spines, at first simple and obtuse, afterwards forked or trifid, their divisions finally again branched and recurved.

SIZE. Length 250 μ; zygospore 80 μ (K.); length 218 μ; diam. 182 μ (R.).

Ralfs. Desm. (1848), p. 70, t. 7, f. 1. Archer in Prit. Inf. (1861), p. 727, t. 2, f. 22, Sp. Cleve Sver. Desm. (1864), p. 487. Lundell Desm. Succ. (1871), p. 11. Wolle Desm. U.S. (1884), p. 109, t. 34, f. 4-8. Nordstedt Norges Desm. (1873), p. 3. Petit Liste Desm. Paris (1877), p. 31. Wood F. Water Algæ U.S. (1872), p. 145, t. 13, f. 6. Wittrock Scan. Desm. (1869), p. 8. Brebisson Liste Desm. (1856), p. 120. Notaris Desm. Ital. (1867), p. 31, t. 1, f. 7. Jacobsen Desm. Denm. (1874), p. 186, partly. Kirchner Alg. Schles. (1878), p. 162.

Micrasterias furcata, var. *b. denticulata*, Rabh. Alg. Eur. (1868), p. 192.

Micrasterias rota, Meneg. Syn. Desm. (1840), p. 215.

Euastrum rota, Ehr. Inf. (1838), t. 12, f. 1 *a*.

Micrasterias rotata, Ralfs. Ann. N. H. (1844), xiv., t. 6, f. 1.

HAB. In boggy pools.

Widely distributed in England, Wales, Scotland; France, Germany, Sweden, Norway, Denmark, Italy, United States.

Plate XXII., fig. a, living frond; *b*, empty frond; *c*, zygospore.

Micrasterias cornuta. *Bennett Micr. Journ.* (1886), VI., *t.* 1, *f.* 6.

Frond oval, very large. Two terminal lobes urn-shaped, very light green, slightly projecting beyond the margin, and quite distinct for their whole length, reaching down to an oval quite colourless space in the centre; ends of terminal lobes colourless, concave, not dentate or fimbriate. Each quarter with two deep and three less deep incisions. Margin perfectly colourless, consisting of six distinct pieces, each with a deep indentation.

SIZE. Length 355 μ; diam. 305 μ (B.).

HAB. In mountain streams.

Lake District.

Plate XXIII., fig. a, living frond; *b*, empty frond (after Bennett).

Micrasterias rotata. *(Grev.) Ralfs. Ann. Nat. Hist.* (1844), XIV. *t.* 6, *f.* 1.

Frond orbicular, smooth, segments five-lobed, basal lobes twice, middle lobes thrice dichotomous, ultimate subdivisions acutely bidentate; end lobe very slightly exserted, its angles very slightly produced, bidentate; ends emarginate. An inflated protuberance in transverse view just over central isthmus.

SIZE. Length 280 μ; zygospore 108 μ (K.); diam. 200-

SIZE. 107-130 × 98-119 μ (K.); diam. 100-125 μ (W.); length 129 μ; diam. 124 μ (D.); length 122 μ; diam. 114 μ (R.).

Ralfs. Desm. (1848), p. 73, t. 9, f. 3. Archer in Prit. Inf. (1861), p. 726, t. 1, f. 22. Delponte Desm. (1876), p. 87, t. 4, f. 7-13. Cleve Sver. Desm. (1864), pp. 487. Lundell Desm. Suec. (1871), p. 14. Wolle Desm. U.S. (1884), p. 111, t. 35, f. 3. Brebisson Liste Desm. (1856), p. 120. Petit Liste Desm. Paris (1877), p. 31. Wittrock Scan. Desm. (1869), p. 9. Rabh. Alg. Eur. (1868), p. 190, partly. Jacobsen Desm. Denm. (1874), p. 188. Kirchner Alg. Schles. (1878), p. 161.

Euastrum crux-melitensis, Ehr. Abh. Berl. Ak. (1831), p. 32. Inf., p. 162, t. 12, f. 3.

HAB. In pools.

Cheshire, Westmoreland, Sussex, Norfolk, Wales; France, Germany, Sweden, Denmark, Italy, United States.

Plate XXI., fig. 2. *a*, living frond; *b*, empty fronds; *c*, transverse view.

Micrasterias Americana. (*Ehr.*) *Ralfs. Desm.* (1848), p. XIX.

Frond angular elliptic, more or less punctate; segments three-lobed; lateral lobes broad, cuneate, their margins concave, inciso-serrate; end lobe broad, cuneate, and exserted, bipartite at the angles, the subdivisions narrow, and minutely dentate at the extremities; end concave.

SIZE. Length 115-153; diam. 92-132 μ (K.); diam, 100-115 μ (W.); length 122 μ; diam 100 μ (R.).

Rabh. Alg. Eur. (1868), p. 189. Kirch. Alg. Schles. (1878), p. 161. Wood F. W. Algæ (1872), p. 143. Wolle Desm. U.S. (1884), p. 112, t. 32, f. 2. Archer in Prit. Inf. (1861), p. 726, t. ii., f. 44. Cleve Sver. Desm. (1864), p. 487. Lundell Desm. Suec. (1871), p. 15. Nordstedt Norges Desm. (1873), p. 6.

Euastrum Americanum, Ehr. Micr. Leb. (1843), t. 4, f. 15.

Micrasterias morsa, Ralfs. Desm. (1848), p. 74, t. 10, f. 1.

HAB. In boggy pools.

Sussex, Wales; France, Germany, Sweden, Norway, United States.

Plate XXX., fig. 1. *a c*, living fronds; *b*, empty frond.

Micrasterias denticulata. *Breb. Alg. Fal.* (1835), *t.* 8.

Frond orbicular, smooth; segments five-lobed; basal and middle lobes twice dichotomous, ultimate subdivisions truncato-emarginate with rounded angles; end lobe simply thrice emarginate. Zygospore orbicular, beset with scattered stout elongate spines, at first simple and obtuse, afterwards forked or trifid, their divisions finally again branched and recurved.

SIZE. Length 250 μ; zygospore 80 μ (K.); length 218 μ; diam. 182 μ (R.).

Ralfs. Desm. (1848), p. 70, t. 7, f. 1. Archer in Prit. Inf. (1861), p. 727, t. 2, f. 22, Sp. Cleve Sver. Desm. (1864), p. 487. Lundell Desm. Suec. (1871), p. 11. Wolle Desm. U.S. (1884), p. 109, t. 34, f. 4-8. Nordstedt Norges Desm. (1873), p. 3. Petit Liste Desm. Paris (1877), p. 31. Wood F. Water Algæ U.S. (1872), p. 145, t. 13, f. 6. Wittrock Scan. Desm. (1869), p. 8. Brebisson Liste Desm. (1856), p. 120. Notaris Desm. Ital. (1867), p. 31, t. 1, f. 7. Jacobsen Desm. Denm. (1874), p. 186, partly. Kirchner Alg. Schles. (1878), p. 162.

Micrasterias furcata, var. *b. denticulata*, Rabh. Alg. Eur. (1868), p. 192.

Micrasterias rota, Meneg. Syn. Desm. (1840), p. 215.

Euastrum rota, Ehr. Inf. (1838), t. 12, f. 1 *a*.

Micrasterias rotata, Ralfs. Ann. N. H. (1844), xiv., t. 6, f. 1.

HAB. In boggy pools.

Widely distributed in England, Wales, Scotland; France, Germany, Sweden, Norway, Denmark, Italy, United States.

Plate XXII., fig. *a*, living frond; *b*, empty frond; *c*, zygospore.

Micrasterias cornuta. *Bennett Micr. Journ.* (1886), VI., *t.* 1, *f.* 6.

Frond oval, very large. Two terminal lobes urn-shaped, very light green, slightly projecting beyond the margin, and quite distinct for their whole length, reaching down to an oval quite colourless space in the centre; ends of terminal lobes colourless, concave, not dentate or fimbriate. Each quarter with two deep and three less deep incisions. Margin perfectly colourless, consisting of six distinct pieces, each with a deep indentation.

SIZE. Length 355 μ; diam. 305 μ (B.).

HAB. In mountain streams.

Lake District.

Plate XXIII., fig. *a*, living frond; *b*, empty frond (after Bennett).

Micrasterias rotata. *(Grev.) Ralfs. Ann. Nat. Hist.* (1844), XIV. *t.* 6, *f.* 1.

Frond orbicular, smooth, segments five-lobed, basal lobes twice, middle lobes thrice dichotomous, ultimate subdivisions acutely bidentate; end lobe very slightly exserted, its angles very slightly produced, bidentate; ends emarginate. An inflated protuberance in transverse view just over central isthmus.

SIZE. Length 280 μ; zygospore 108 μ (K.); diam. 200-

250 μ (W.); length 255 μ; diam. 243 μ (R.); length 288 μ; diam. 250 μ (D.).

Ralfs. Desm. (1848), p. 71, t. 8, f. 1. Archer in Prit. Inf. (1861), p. 727, t. 1, f. 20. Delponte Desm. (1876), p. 83, t. 4, f. 1. Cleve Sver. Desm. (1864), p. 486. Lundell Desm. Suec. (1871), p. 12. Wolle Desm. U.S. (1884), p. 109, t. 34, f. 1-3. Nordstedt Norges Desm. (1873), p. 5. Wittrock Scan. Desm. (1869), p. 8. Brebisson Liste Desm. (1856), p. 120. Notaris Desm. Ital. (1867), p. 30, t. 1, f. 6. Jacobsen Desm. Denm. (1874), p. 186. Kirchner Alg. Schles. (1878), p. 162.

Micrasterias furcata, Rabh. Alg. Eur. (1868), p. 191, in part.

Echinella rotata, Greville in Hook. Br. Fl. (1830), v., pt. 2, pp. 398.

Euastrum rota, Ehr. Abh. Berl. Ak. (1831), p. 82. Ehr. Inf., t. 12, f. 1 *c e*.

Eutomia rotata, Harvey Man. Br. Alg. (1841), p. 187.

HAB. In clear pools and ditches.

Generally distributed in England, Wales, Scotland; France, Germany, Sweden, Denmark, Norway, Italy, United States.

Plate XXIV., fig. *a*, living frond; *b*, empty frond; *c*, transverse view; *d*, zygospore.

Micrasterias Thomasiana. *Archer Micr. Journ.* (1862), II., *p.* 239, *t.* 12, *f.* 1-10.

Frond orbicular, smooth; segments five-lobed, furnished at the base with three stout conspicuous, prominent, hollow projections, the middle conical, rounded, the outer tapering, curved, elongate, emarginate, divergent; lobes closely approximate throughout, each bearing two or three superficial, regularly-disposed, apiculate elevations, their spines directed outwards; the lateral lobes dichotomously divided, their ultimate subdivisions bi- or tridentate, or sometimes quadridentate, not tapering; end lobe wholly included, acutely emarginate, its angles acute. End view, the body of the segment lanceolate, projections very conspicuous, together presenting a doubly hastate outline.

SIZE. Length 200 μ; diam. 177 μ (A.).

Lundell Desm. Suec. (1871), p. 11. Nordstedt Norges Desm. (1873), p. 5. Rabh. Alg. Eur. (1868), p. 192.

Micrasterias denticulata, forma *Thomasiana*, Jacobsen Desm. Denm. (1874), p. 187.

HAB. In pools.

Ireland; Sweden, Norway, Denmark.

Plate XXV., fig. 1. *a*, living frond; *b*, empty frond; *d*, *e*, *f*, *g*, transverse and end views.

Micrasterias conferta. *Lund. Desm. Suec. p.* 14, *t.* 1, *f.* 5.

Small, a little longer than broad, broadly elliptic, sinus deep, very narrow, linear; semi-cells five-lobed; lobes crowded, polar lobe subcuneate, dilated from the narrow base; sides concave, margin of the obtuse angles furnished with two or three minute papillæ; lateral lobes equal, cut in two lobules, with 2-4 minute papillæ at the margin; semi-cells oblong, lanceolate in a vertical view, in side view oblong; membrane punctate, often reddish.

SIZE. Long. 84-87 μ; diam. 74-78 μ (L.).

Wolle Desm. U.S. (1884), p. 114, t. 53, f. 12.

Micrasterias crenata, Cleve Bidrag, p. 487.

Micrasterias granulata, Wood F. W. Alg. U.S. (1872).

HAB. In pools.

Scotland, Sweden, United States.

Plate XXVIII., fig. 2. *a*, living frond; *b*, empty frond.

Micrasterias fimbriata. *Ralfs. Desm.* (1848), *p.* 71, *t.* 8, *f.* 2.

Frond orbicular, smooth; segments five-lobed, basal lobes twice, middle lobes generally thrice dichotomous; ultimate subdivisions obtusely emarginate, each furnished with two curved acute spines; end lobe somewhat exserted, the angles slightly produced and rounded, and each furnished with two or three minute spines; ends concave.

SIZE. Length 150-250; diam. 125-200 μ (K.); length 233 μ; diam. 213 μ (R.).

Rabh. Alg. Eur. (1868), p. 193. Jacobsen Desm. Denm. (1874), p. 187. Kirch. Alg. Schles. (1878), p. 162. Wolle Desm. U.S. (1884), p. 109, t. 36, f. 1-8. Archer in Prit. Inf. (1861), p. 727. Cleve Sver. Desm. (1864), p. 486. Lundell Desm. Suec. (1871), p. 13. Wood F. Water Algæ U.S. (1872), p. 145.

Euastrum rota, Ehr. Inf. (1838), t. 12, f. d.

HAB. In boggy pools.

North Wales; Germany, Sweden, Denmark United States.

Pate XXVI., fig. 1. *a*, living frond; *b c*, empty fronds.

Micrasterias radiosa. *Ag. Bot. Zeit.* (1827).

Frond orbicular, smooth, segments five-lobed, basal lobes twice, middle lobes generally thrice dichotomous, ultimate subdivisions inflated, attenuate towards the end, bidentate, end lobe emarginate, its angles dentate.

SIZE. Length 150 μ; diam. 144 μ (D); 182 × 182 μ (R.).

Rabh. Alg. Eur. (1868), p. 192. Brebisson Liste (1856), p. 120. Wittrock Scan. Desm. (1869), p. 9. Wolle Desm. U.S. (1884), p. 109, t. 31, f. 1-3. Ralfs. Desm. (1848), p. 72, t. 8, f. 3. Archer in Prit. Inf. (1861), p. 727, t. 1, f. 21. Delponte Desm. (1876), p. 85, t. iv., f. 2-4. Cleve Sver. Desm. (1864), p. 486. Lundell Desm. Suec. (1871), p. 13. Wood F. Water Algæ U.S. (1872), p. 145.

Euastrum sol., Ehr. Mikr. Leb. S. and N. Amer. (1843), t. 4, f. 16.

HAB. In clear pools.

North Wales, Ireland ; France, Sweden, Italy, United States.

Plate XXVII., fig. 1. *a*, living frond ; *b*, empty frond.

Micrasterias papillifera. *Breb. in Ralfs. Desm.* (1848), *p.* 72, *t.* 9, *f.* 1.

Frond orbicular, having the principal sinuses bordered by a row of minute granules, otherwise smooth ; segments five-lobed; basal and middle lobes twice dichotomous, their ultimate shallow subdivisions terminated by two, sometimes three, gland-like teeth ; end lobe emarginate, its angles dentate. Zygospore orbicular, spinulose ; spines stout, scattered, elongated, at first simple and obtuse, then once or twice furcate, tips recurved.

SIZE. Length 110-135 μ ; diam. 100-125 μ (K.). ; length 110-120 μ; diam. 106-120 μ (R.).

Wolle Desm. U.S. (1884), p. 109, t. 32, f. 8-9. Archer in Pritch. Inf. (1861), p. 727, t. 1, f. 18, 19. Delponte Desm. (1876), p. 86, t. 4 f. 5, 6). Cleve Sver. Desm. (1864), p. 486. Lundell Desm. Suec. (1871), p. 13. Nordstedt Norges Desm. (1873), p. 6. Nordstedt Desm. Arct. (1875), p. 41. Petit Liste Desm. Paris (1877), p. 31. Wood F. Water Algæ U.S. (1872), p. 146. Brebisson Liste Desm. (1856), p. 120. Notaris Desm. Ital. (1867), t. 2, f. 8. Rabh. Alg. Eur. (1868), p. 194. Jacobsen Desm. Denm. (1874), p. 188. Kirchner Alg. Schles. (1878), p. 163.

HAB. In pools.

Sussex, Hants, Surrey, Westmoreland, Cornwall, Wales, Scotland, Ireland ; France, Germany, Italy, Sweden, Denmark, Russian Lapland, United States.

Plate XXVII., fig. 2. *a*, living frond ; *b e*, empty fronds ; *d*, end view ; *e*, side view.

Micrasterias truncata. (*Corda.*) *Breb. in Ralfs. Desm.* (1848), *p.* 75, *t.* 8, *f.* 4 ; *t.* 10, *f.* 5.

Frond orbicular, smooth, segments five-lobed, basal and middle lobes obscurely bipartite, extremities bidentate ; end lobe very broadly cuneate, bidentate at the angles, and with a slight central concavity.

SIZE. Length 94-107 μ; diam. 84-108 μ (K.) μ; diam., 50-100 μ (W.).; length 106 μ; diam. 100 μ (R.).; length 115 μ; diam. 96 μ (D.).

Archer in Prit. Inf. (1861), p. 727. Delponte Desm. (1866), p. 89, t. v., f. 6-10. Cleve Sver. Desm. (1864), p. 487. Lundell Desm. Suec. (1871), p. 16. Wolle Desm. U.S. (1884), p. 114, t. 38, f. 6-9. Nordstedt Norges Desm. (1873), p. 7. Petit Liste Desm. Paris (1877), p. 31. Wood F. Water Algæ U.S. (1872), p. 145. Wittrock Scan. Desm. (1869), p. 9. Brebisson Liste Desm. (1856), p. 121. Notaris Desm. Ital. (1867), p. 32, t. 2, f. 9. Rabh. Alg. Eur. (1868), p. 191, in part. Jacobsen Desm. Denm. (1874), p. 185. Kirchner Alg. Schles. (1878), p. 162.

Cosmarium truncatum, Corda Alm. Carls. (1835), f. 23.

Euastrum rota, Ehr. Inf. (1838), t. 12, f. 1, *g*, *h*.

Euastrum scutum, Focke. Phys. Stud. (1854), t. 1, f 14, t. 3, f. 10, 11.

Micrasterias semiradiata, Kutz. Sp. Alg. (1849). p. 170.

Micrasterias rotata, Ralfs. Ann. N. Hist. (1844), xiv., t. 6, f. i. *b*.

Euastrum semiradiatum, Breb. in Meneg. Syn. Desm. (1840), Näg. Einz. Alg. (1849), t. 6, f. H. 3.

HAB. In ponds.

Sussex, Hants, Cornwall, Gloucester, Westmoreland, Wales, Scotland, Ireland; Germany, France, Italy, Sweden, Denmark, United States.

Plate XXV., fig. 2. *a*, living frond; *b*, empty frond; *c*, side view; *d*, end view.

Micrasterias crenata. *Breb. in Ralfs. Desm.* (1848), *p.* 75, *t.* 7, *f* 2, *t.* 10, *f.* 4.

Frond orbicular, smooth, segments five-lobed, basal and middle lobes usually crenate or sinuate, end lobe very broadly cuneate, rounded at the ends, entire.

SIZE. Length 106 μ; diam. 96 μ (R.); length 180 μ; diam. 86 μ (D.); diam. 75-85 μ (W.).

Grunow Desm. Austr. (1858), p. 501. Archer in Prit. Inf. (1861), p. 727. Delponte Desm. (1876), p. 92, t. 5, f. 17, 18. Wolle Desm. U.S. (1884), p. 113, t. 33, f. 7, 8.

Micrasterias rotata, Ralfs. Ann. Nat. Hist. (1844), xiv., t. 6, fig. 1, *b* (upper fig.)

Micrasterias truncata, var. *c.*, Rabh. Alg. Eur. (1868), p. 191.

HAB. In pools.

Sussex, Wales; Italy, Austria, United States.

Plate XXVIII., fig. 1. *a b,* living fronds; *c,* empty frond.

Micrasterias Jenneri. *Ralfs. Desm.* (1848), *p.* 76, *t.* 11, *f.* 1.

Frond oblong, minutely granulated, segments five-lobed, basal, middle, and end lobes cuneate, obscurely bipartite, and their sub-divisions emarginate, or with merely a slight central concavity, angles rounded, end lobe at external margin considerably the broadest.

SIZE. Length 172 μ; diam. 120 μ (R.); diam. 100-150 μ (W.).

Archer in Prit. Inf. (1861), p. 728. Cleve Sver. Desm. (1864), p. 486. Lundell Desm. Suec. (1871), p. 11. Nordstedt Norges Desm. (1873), p. 5. Wood F. Water Algæ U.S. (1872), p. 146. Rabh. Alg. Eur. (1868), p. 194, in part. Jacobsen Desm. Denm. (1874), p. 186. Wolle Desm. U.S. (1884), p. 115, t. 33, f. 1, 2.

HAB. In bogs.

Britain, Sweden, Norway, Denmark, United States.

Plate XXVIII., fig. 3. *a,* living frond; *b,* empty frond; *c,* end view.

var. *α.* *Ralfs. Desm.*, p. 76.

Granules like mere puncta, lobes slightly bipartite, sub-divisions emarginate.

Sussex, Hants, Wales.

var. *β.* *Ralfs. Desm.*, p. 76.

Granules larger, giving a dentate appearance to the margin.

Sussex.

var. *γ.* *Archer in Pritch. Infus.* (1861), p. 728.

Granules giving a rough appearance to the margin, lobes slightly concave, margins rounded, not bipartite, without emarginate sub-divisions.

Micrasterias angulosa. *Hantsch. in Reinsch. Algenflora* (1867), *p.* 147, *t.* 8, *f.* 2.

Front view elliptic, more or less octangular, semi-cells five lobed, terminal lobe deltoid, lateral lobes equally, two or three lobate, angles of all the lobules unarmed, rounded. Sinus deep, linear. Cell membrane densely but finely tuberculate.

SIZE. Length 255 μ; diam. 208 μ (R.); length 305 μ; diam. 244 μ.

Archer in Micr. Journ. xvi. (1876), p. 109. Lundell Desm. Suec. (1871), p. 11. Nordstedt Norges Desm. (1873), p. 5. Jacobsen Desm. Denm. (1874), p. 186.

Micrasterias Jenneri, var. *b. angulosa*, Rabh. Alg. Eur. (1868), p. 194.

HAB. In pools.

Ireland, Warwickshire; Sweden, Norway, Denmark.

Plate XXIX., fig. a, living frond; *b*, empty frond; *c*, side view.

Micrasterias brachyptera. *Lund. Desm. Suec.* (1871), 12, *t.* 1, *f.* 4.

Large, about one-third longer than broad, circumference elliptic, deeply constricted, semi-cells 5-lobed, end lobe extending beyond the lateral lobes, narrowed gradually upwards, but at the apex a little dilated into truncate two-spined angles, terminal margin waved, concave, often with two spines, intermediary and basal lobes equal, abbreviated, bilobulate, lobules emarginate, furnished with incurved spines. Semi-cells with the ventral margin spinulose. Membrane punctate.

SIZE. Length 191 μ; diam. 131 μ (T.); length 200-214 μ; diam. 140-150 μ (L.); length 200-210 μ; diam. 140-150 μ (W.).

Turner in Roy. Micr. Journ. (1885), v., p. 937, t. xvi., f. 15. Wolle Desm. U.S. (1884), p. 110, t. 32, f. 6, 7.

HAB. Mountain streams.

Bowness, Windermere; Sweden, United States.

Plate XXX., fig. 2. *a*, living frond; *b c*, empty fronds; *d*, side view; *e*, end view.

GENUS 15. **EUASTRUM.** *Ehr.* (1831).

Frond longer than broad, compressed; deeply constricted into two-lobed or sinuated segments; segments usually pyramidal, 5 or 3-lobed or merely sinuous, possessing variously disposed circular inflated protuberances (rarely absent); lateral lobes opposite, very rarely radiant, rounded or sinuated at extremities; end lobes acutely incised or emarginate at the centre, rarely only concave; central constriction linear.

Euastrum verrucosum. *Ehr. Abh. Berl. Akad.* (1833), *p.* 247.

Frond somewhat longer than broad, rough all over with conic granules; segments three-lobed, somewhat divergent, all the lobes broad, cuneate with a very broad shallow external sinus. Empty frond inflated and verrucose; semi-cells with one large central inflation, and a smaller one on each side, two on end lobe.

SIZE. 90×90 μ (R.); 100×100 μ (D.); diam. 75 μ (W.).

Ehr. Infus., t. 12, f. 5. Ralfs. Desm. (1848), p. 79, t. 11, f. 2. Archer in Prit. Inf. (1861), p. 728. Hassall Fr. Alg. (1845), p. 379. Delponte Desm. (1876), p. 94, t. vi, f. 13-15. Cleve Sver. Desm. (1864), p. 486. Wolle Desm. U.S. (1884), p. 100, t. 26, f. 1-5. Lundell Desm. Suec. (1871), p. 16. Nordstedt Norges Desm. (1873), p. 7. Petit Liste Desm. Paris (1877), p. 30. Wood F. Water Algæ U.S. (1872), p. 136. Wittrock Scan. Desm. (1869), p. 8. Brebisson Liste Desm. (1856), p. 123. Notaris Desm. Ital. (1867), p. 33, t. 2, f. 10. Rabh. Alg. Eur. (1868), p. 179. Jacobsen Desm. Denm. (1874), p. 189. Kirchner Alg. Schles. (1878), p. 160.

Cosmarium verrucosum, Meneg. Syn. Desm. (1844), p. 222.
Euastrum papulosum, Kutz.

HAB. In pools, amongst *Sphagnum.*

Hants, Kent, Sussex, Surrey, Cornwall, Westmoreland, Middlesex, Wales, Scotland; Germany, France, Sweden, Denmark, Norway, Italy, United States.

Plate XXXI., fig. 1. *a*, living frond; *b*, empty frond; *c*, end view; *d*, side view.

Euastrum oblongum, *Grev. Ralfs. Desm.* (1848), *p.* 80, *t.* 12.

Frond rather more than twice as long as broad, smooth, oblong; segments five-lobed; lobes nearly equal, cuneate; lateral lobes or the basal only, with a broad, shallow, marginal concavity, all their angles rounded; terminal notch linear. Empty frond punctate, with three large inflations at base of each semi-cell, two others above, and two smaller in terminal lobe. Zygospore orbicular, tuberculose.

SIZE. Length 160 μ; diam. 86 μ (R.); length 165 μ; diam. 93 μ (D.); diam. 68-75 μ (W.); zygospore 140 μ (R.).

Archer in Prit. Inf. (1861), p. 728, t. 13, f. 11. Hassall Fr. Alg. (1845), p. 380. Ralfs. Brit. Algæ No. 28. Delponte Desm. (1876), p. 100, t. vi, f. 26-30. Cleve Sver. Desm. (1864), p. 485. Wolle Desm. U.S. (1884), p. 98, t. 25, f. 5-7. Lundell Desm. Suec. (1871), p. 17. Nordstedt Desm. Arct. (1875), p. 41. Petit Liste Desm. Paris (1877), p. 30. Wood F. Water Algæ U.S. (1872), p. 136. Wittrock Scan. Desm. (1869), p. 6. Brebisson Liste Desm. (1856), p. 123. Notaris Desm. Ital. (1867), p. 34, t. 2, f. 11. Rabh. Alg. Eur. (1868), p. 181. Jacobsen Desm. Denm. (1874), p. 190. Kirchner Alg. Schles. (1878), p. 167.

Echinella oblonga, Grev. in Hook. Br. Fl., v., pt. 2 (1830), p. 398.

Euastrum pecten, Ehr. Abh. Berl. Ak. (1831), p. 82. Inf., t. 12, f. 4. Focke Phys. Stud. (1847), t. 1, f. 10, t. 2, f. 8, 9.

Cosmarium sinuosum, Corda Alm. Carls. (1835), p. 121, t. 2, f. 21.

Micrasterias sinuata, Breb. Alg. Fal. (1835), p. 55, t. 7.

Eutomia oblonga, Harvey Br. Alg. (1841), p. 188.

Cosmarium oblongum, Breb. in Meneg. Syn. Desm. (1840), p. 221.

HAB. In pools.

Generally distributed in England, Wales, Scotland, Ireland; France, Germany, Italy, Sweden, Russian Lapland, Denmark, United States.

var. β. Smaller, narrower, middle lobes rounded without any marginal concavity.

Plate XXXI., fig. 2. *a*, living frond; *b*, empty frond; *c*, side view; *d e*, transverse views; *f*, zygospore.

Euastrum crassum. *Kutz. Phyc. Germ.* (1845), *p.* 135.

Frond about twice as long as broad, sub-quadrilateral, smooth, segments three-lobed, basal lobes very broad, with a very broad, shallow marginal sinus, in which there is sometimes a slight intermediate rounded projection; end lobe cuneate, rounded, terminal notch linear; empty frond punctate; semi-cells with three inflations below and two above.

SIZE. Length 127-190 μ; diam. 95 μ (R.); diam. 68-82 μ (W.)

Ralfs. Desm. (1848), p. 81, t. 11, f. 3. Archer in Prit. Inf. (1861), p. 728. Cleve Sver. Desm. (1864), p. 485. Nordstedt Norges Desm. (1873), p. 8. Brebisson Liste Desm. (1856), p. 122. Notaris Desm. Ital. (1867), p. 34, t. 2, f. 12. Wolle Desm. U.S. (1884), p. 97, t. 25, f. 1-3. Lundell Desm. Suec. (1871), p. 17 (?). Petit Liste Desm. Paris (1877), p. 30. Wood F. Water Algæ U.S. (1872), p. 137. Rabh. Alg. Eur. (1868), p. 181. Jacobsen Desm. Denm. (1874), p. 190. Kirchner Alg. Schles. (1878), p. 157.

Cosmarium crassum, Breb. in Meneg. Syn. Desm. (1840), p. 222.

Euastrum pelta, Hassall Fr. Alg. (1845), p. 380. Ralfs. Ann. Nat. Hist. (1844), xiv., t. 7, f. 1.

HAB. In pools and ponds.

Generally distributed in England, Wales, Scotland;

France, Germany, Denmark, Sweden, Norway, Italy, United States.

var. *β*. *Ralfs. Desm.* (1848), p. 81, t. 11, f. 3, *e f*.

Smaller, margins of lateral lobes more concave, sinuations between the lateral and end lobes more closed, the latter more indented.

HAB. In pools.

North Wales.

Plate XXXII., fig. 1. *a b*, living frond; *c*, empty frond; *d*, transverse view.

Euastrum pinnatum. *Ralfs. Desm.* (1848), *p.* 81, *t.* 13, *f.* 1.

Frond oblong, about twice as long as broad; segments five-lobed, in a pinnatifid manner; basal lobes slightly emarginate; middle smaller, rounded, entire; end lobe exserted, dilated, its notch linear; the upper margin of the lobes horizontal; empty frond punctate; semi-cells with two large inflations near the base, four smaller between, three others above, and two on each end lobe.

SIZE. Length 130 μ; diam. 70 μ (R.); diam. 60-70 μ (W.).

Archer in Prit. Inf. (1861), p. 729. Cleve Sver. Desm. (1864), p. 485. Lundell Desm. Suec. (1871), p. 19. Norstedt Norges Desm. (1873), p. 8. Petit Liste Desm. Paris (1877), p. 30. Rabh. Alg. Eur. (1868), p. 182. Wolle Desm. U.S. (1884), p. 98, t. 28, f. 14-16.

HAB. In pools.

North Wales; France, Sweden, Norway, United States.

Plate XXXII., fig. 2. *a*, living frond; *b c*, empty fronds; *d*, transverse view; *e*, side view; *f*, end view.

Euastrum humerosum. *Ralfs. Desm.* (1848), *p*, 82, *t.* 13, *f.* 2.

Frond about twice as long as broad; segments somewhat five-lobed; basal lobes slightly emarginate; middle lobes narrow, directed upwards, resembling processes; end lobe with a short neck, partly included between the middle lobes, dilated, its notch linear. Empty frond minutely punctate. Semi-cells with three inflations at base, two above, and two on end lobe.

SIZE. Length 110 μ; diam. 65 μ (R.); diam. 75 μ (W.).

Archer in Prit. Inf. (1861), p. 729. Cleve Sver. Desm. (1864), p. 485. Lundell Desm. Suec. (1871), p. 19. Nordstedt Norges Desm. (1873), p. 8. Brebisson Liste

Desm. (1856), p. 122. Rabh. Alg. Eur. (1868), p. 182. Wolle Desm. U.S. (1884), p. 99, t. 28, f. 12, 13.

HAB. In pools.

Hants, Wales; France, Sweden, Norway, United States.

Plate XXXII., fig. 3. *a*, living frond; *b c*, empty fronds; *d*, transverse view.

Euastrum multilobatum. *Wood F. W. Algæ*, 135, *t.* 12, *f.* 10.

Frond about twice as long as wide, deeply constricted; sinus moderately large; from the lateral view somewhat enlarged, and doubly biumbonate in the middle; semi-cells from the front trilobate, the lobes separated by very wide sinuses; basal lobe broadly emarginate; central lobe obtuse; end lobe broadly and shallowly sinuate-emarginate; semi-cells from the vertex five-lobed; cell membrane smooth.

SIZE. Diam. 62 μ; length 120 μ (W.); length 90 μ; diam. 65 μ (B.).

Wolle Desm. U.S. (1884), p. 98, t. 53, fig. 11. Bennett, Roy. Micr. Journ. (1886), p. 1, t. 1, fig. 11.

HAB. Lakes and pools.

Loughrigg (Lake District); United States.

Plate XXXV., fig. 15. *a*, living frond; *b*, empty frond.

Euastrum ventricosum. *Lund. Desm. Suec., t.* 2, *f.* 2.

Large, twice as long as broad, outline sub-elliptic, deeply constricted at the middle, resembling small forms of *E. crassum* in front view. Semi-cells in side view sub-rectangular, end broadly and flatly rounded, sides somewhat contracted near the apex, producing a lobule on each side, another lobule between base and apex. End view broadly elliptic, with four (or five) swellings on each side. Zygospore orbicular, furnished with numerous short, stout, obtusely pointed conical tubercles.

SIZE. Length 88 μ; diam. 50 μ (W.); length 105 μ; diam. 66-69 μ (L.).

Wolle Desm. U.S. (1884), p. 160.

HAB. Pools.

Lake District (England); Sweden, United States.

Plate XXXIII., fig. 1. *a*, living frond; *b*, empty frond; *c*, side view; *d*, end view.

Euastrum affine. *Ralfs. Ann. Nat. Hist.* (1844), 14, *t.* 7, *f.* 3.

Frond about twice as long as broad; segments three-lobed; basal lobes slightly emarginate, having intermediate between them and the end lobe on each side, a tubercle representing middle lobes, the upper margin of which is horizontal; end lobe exserted, dilated, its notch linear. Empty frond minutely punctate. Semi-cells with four basal inflations, two above and two on end lobe.

SIZE. Diam. 45-50 μ (W.); length 110 μ; diam. 50 μ (R.).

Ralfs. Desm. (1848), p. 82, t. 13, f. 3. Archer in Prit. Inf. (1861), p. 729. Rabh. Alg. Eur. (1868), 182. Cleve Sver. Desm. (1864), 485. Lundell Desm. Succ. (1871), p. 19. Nordstedt Norges Desm. (1873), p. 8. Petit Liste Desm. Paris (1877), p. 31. Wood. F. Water Algæ U.S. (1872), p. 138. Brebisson Liste Desm. (1856), p. 122. Wolle Desm. U.S. (1884), 100, t. 25, f. 11, 12. Jacobsen Desm. Denm. (1874), p. 190.

HAB. Pools.

Westmoreland, Sussex, Hants, Wales, Scotland; France, Sweden, Denmark, Norway, United States.

Plate XXXIII., fig. 2. *a*, living frond; *b*, empty frond; *c*, side view; *d*, end view.

Euastrum ampullaceum. *Ralfs. Desm.* (1848), *p.* 83, *t.* 13, *f.* 4.

Frond rather more than one-half longer than broad, segments obscurely three-lobed, short, with broad inflated base; basal lobes not emarginate, having on each upper side a small intermediate tubercle between each and the end lobe; end lobe exserted and dilated, its notch linear. Empty frond minutely punctate, inflations indistinct or confluent; transverse view with four inflations at side and one at each end.

SIZE. Diam. 62-75 μ (W.); length 88-98 μ; diam. 67 μ (K.); length 90 μ; diam. 60 μ (R.); length 104 μ; diam. 63 μ (D.).

Archer in Prit. Inf. (1861), p. 729. Delponte Desm. (1876), p. 104, t. vi., f. 3, 4. Lundell Desm. Succ. (1871), p. 19. Kirch. Alg. Schles. p. 158. Nordstedt Norges Desm. (1873), p. 8. Wood F. Water Algæ U.S. (1872), p. 138. Wittrock Scan. Desm. (1869), p. 6. Brebisson Liste Desm. (1856), p. 123. Rabh. Alg. Eur. (1868), p. 183. Wolle Desm. U.S. (1884), 100, t. 28, f. 8-11.

Euastrum, Hassall Fr. Alg. (1845), t. 90, f. 11.

HAB. In ponds and pools.

Kent, Sussex, Hants, Westmoreland, Wales; France, Norway, Sweden, Italy, United States.

Plate XXXIII., fig. 3. *a*, living frond; *b*, empty frond; *c*, side view; *d*, end view.

Euastrum insigne. *Hass. Alg.* (1845), *t.* 91, *f.* 2.

Frond rather more than twice as long as broad; segments inflated at base, sides entire, without lateral tubercles, and tapering into a long slender neck; end lobe dilated, its notch linear. Empty frond minutely punctate; semi-cells in front view with two inflations at the base.

SIZE. Diam. 30-35 μ (W.); length 100-107 μ; diam. 49-61 μ (K.); length 110 μ; diam. 60 μ (R.).

Ralfs. Desm. (1848), p. 83, t. 13, f. 6. Archer in Prit. Inf. (1861), p. 729, t. 3, f. 12. Cleve Sver. Desm. (1864), p. 484. Lundell Desm. Suec. (1871), p. 21. Nordstedt Norges Desm. (1873), p. 9. Wood F. Water Algæ U.S. (1872), p. 139. Wittrock Scan. Desm. (1869), p. 6. Rabh. Alg. Eur. (1868), p. 184 (sine var. β.). Kirchner Alg. Schles. (1878), p. 158. Wolle Desm. U.S. (1884), p. 102, t. 27, f. 39-43.

HAB. Ponds and pools.

Hants, Westmoreland, Wales, Scotland; Germany, Sweden, Norway, United States.

Plate XXXIII., fig. 4. *a*, living frond; *b c*, empty fronds; *d*, side view; *e*, end view.

Euastrum didelta. *Ralfs. Ann. Nat. Hist.* (1844), *p.* 190, *t.* 7, *f.* 2, *a*, *b*.

Frond rather more than twice as long as broad; segments pyramidal, inflated at the base and again at the middle; end scarcely dilated, rounded, its notch linear. Empty frond punctate; semi-cells in front view with several inflations in lines, and two at the end in transverse view with four inflations at each side and one at each end. Zygospore orbicular, with subulate spines.

SIZE. Length 45-54 μ; diam. 22-25 μ (W.); length 110-140 μ; diam. 60-70 μ (K.); length 135 μ; diam. 65 μ (R.); length 144 μ; diam. 72 μ (D.).

Ralfs. Desm. (1848), p. 84, t. 14, f. 1. Archer in Prit. Inf. (1861), p. 729, t. 1, f. 23, 24, 25. Delponte Desm. (1876), p. 105, t. vi., f. 2. Cleve Sver. Desm. (1864), p. 485. Lundell Desm. Suec. (1871), p. 19. Nordstedt Norges Desm. (1873), p. 9. Nordstedt Desm. Arct. (1875), p. 41. Brebisson Liste Desm. (1856), p. 123. Wolle Desm. U.S. (1884), p. 99, t. 29, f. 9, 10. Wood F. Water Algæ U.S. (1872), p. 139. Notaris Desm. Ital. (1867), p. 35, t. 3, f. 13. Rabh. Alg. Eur. (1868), p. 184. Jacobsen Desm. Denm. (1874), p. 190. Kirchner Alg. Schles. (1878), p. 157.

Heterocarpella didelta, Turp. Mem. (1828), p. 295.

Cosmarium didelta, Meneg. Syn. Desm. (1840), p. 219.

HAB. In pools.

Kent, Sussex, Hants, Westmoreland, Cornwall, Wales, Scotland; France, Germany, Sweden, Norway, Russian Lapland, Denmark, Italy, United States.

Plate XXXIV., fig. 1. *a,* living frond; *b e,* empty fronds; *c,* end view; *d,* side view.

Euastrum cuneatum. *Jenner in Ralfs. Desm.* (1848), *p.* 90, *t.* 32, *f.* 3.

Frond large, rather more than twice as long as broad, segments pyramidal, broadest at the base and narrowing upwards, not lobed, the sides almost straight; ends truncate, central notch linear. Empty frond without inflations.

SIZE. Length 118 μ; diam. 55 μ (R.); length 96-100 μ; diam. 47-50 μ (L.); length 92-117 μ; diam. 45-62 μ (K.).

Archer in Prit. Inf. (1861), p. 731. Lundell Desm. Suec. (1871), p. 19. Nordstedt Norges Desm. (1873), p. 9. Rabh. Alg. Eur. (1868), p. 187. Kirchner Alg. Schles. (1878), p. 159.

HAB. In pools.

Sussex, Wales, Scotland; Germany, Sweden, Norway.

Plate XXXIV., fig. 6. *a,* living frond; *b,* empty frond.

Euastrum ansatum. *(Ehr.) Ralfs. Desm.* (1848), *p.* 85, *t.* 14, *f.* 2.

Frond about twice as long as broad; segments inflated at the base, tapering upwards without sinuations into a neck, and not dilated; rounded, its notch linear. Empty frond punctate, turgid in the middle.

SIZE. Diam. 25-36 μ (W.); length 76 μ; diam. 38 μ (R.); length 75-88 μ; diam. 37-41 μ (K.); length 86 μ; diam. 43 μ (D.).

Ehr. Inf. (1838), t. 12, f. 6. Archer in Prit. Inf. (1861), p. 729. Delponte Desm. (1876), p. 101, t. vi, f. 31. Cleve Sver. Desm. (1864), p. 485. Lundell Desm. Suec. (1871), p. 20. Nordstedt Norges Desm. (1873), p. 9. Nordstedt Desm. Arct. (1875), p. 41. Wolle Desm. U.S. (1884), p. 99, t. 25, f. 8-10; t. 29, f. 11, 12. Brebisson Liste Desm. (1856), p. 123. Notaris Desm. Ital. (1867), p. 35, t. 3, f. 14. Jacobsen Desm. Denm. (1874), p. 190. Kirchner Alg. Schles. (1878), p. 158.

Euastrum Ralfsii, Rabh. Alg. Eur. (1868), p. 184. Petit Liste Desm. Paris (1877), p. 31. Wood F. Water Algæ U.S. (1872), p, 139. Wittrock Scan. Alg. (1869), p. 6.

Euastrum binale, Kutz. Phy. Germ. (1845), p. 135.

Euastrum didelta, Ralfs. Ann. Nat. Hist. (1844), xiv., p. 190 (in part), t. 7, f. 2, *c, d, e, f.*

Hab. In pools.

Widely distributed in England, Wales, Scotland; France, Germany, Norway, Denmark, Sweden, Russian Lapland, Italy, United States.

Plate XXXIII., fig. 5. *a*, living frond; *b c*, empty fronds; *d*, side view; *e*, end view.

Euastrum circulare. *Hass. Alg.* (1845), *p.* 383, *t.* 90, *f.* 5.

Frond about twice as long as broad, tapering upwards into a neck, end not dilated, its notch an acute incision. Empty semicells with five basal inflations, four in a semicircle around the fifth, with two others at the extremity.

Size. Diam. 36 μ (W.); length 82-90 μ; diam. 52-54 μ (K.).

Ralfs. Desm. (1848), p. 85 (partly), t. 14, f. 3*a*. Archer in Prit. Inf. (1861), p. 729. Kirch. Alg. Schles. (1878), p. 158. Cleve Sver. Desm. (1864), p. 485. Notaris Desm. Ital. (1867), p. 36, t. 3, f. 16. Grunow Desm. Aust. (1858), p. 501. Wood F. Water Algæ U.S. (1872), p. 139. Wolle Desm. U.S. (1884), p. 101, t. 28, f. 1, 2.

Euastrum circulare, var. *Hassallii*, Breb. Liste Desm. (1856), p. 122. Rabh. Alg. Eur. (1868), p. 183.

Cosmarium circulare, Kutz. Spec. Alg. (1849), p. 174.

Hab. In pools and ponds.

Essex, Scotland; France, Germany, Sweden, Austria, Italy, United States.

Plate XXXIV., fig. 2. *a*, living frond; *b c*, empty fronds.

Euastrum sinuosum. *Lenor* (1845), *in Ralfs.*

Frond about twice as long as broad, segments three-lobed, basal portion emarginate at the sides; end lobe somewhat dilated, its notch linear. Empty frond punctate, semi-cells in front view with five basal inflations and two others at the extremity; transverse view with three inflations at each side, and one at each end.

Size. Length 76 μ; diam. 45 μ (R.).

Archer in Prit. Inf. (1861), p. 729. Lundell Desm. Suec. (1871), p. 20. Jacobsen Desm. Denm. (1874), p. 190. Nordstedt Norges Desm. (1873), p. 9.

Euastrum circulare, var. β., Ralfs. Desm. (1848), p. 85, t. 13, f. 5, *a, b, d.*

Euastrum circulare, var. *Falasiensis*, Breb. Liste Desm. (1856), p. 122. Rabh. Alg. Eur. (1868), p. 183.

Hab. In pools.

Westmoreland, Hants, Wales; France, Sweden, Norway, Denmark.

Plate XXXIV., fig. 3. *a c*, living fronds; *b d*, empty fronds; *e*, end view.

Euastrum Jenneri. *Archer in Pritch. Infus.* (1861), *p.* 729.

Frond scarcely twice as long as broad; segments three-lobed, basal portion subquadrate, emarginate at the sides; end lobe somewhat dilated, its notch linear. Empty frond punctate, semi-cells in front view with several small inflations in alternate lines.

Size. Length 76 μ; diam. 48 μ (R.).

Euastrum circulare, var. *Ralfsii*, Brebisson Liste Desm. (1856), p. 122. Wood F. Water Algæ U.S. (1872), p. 139. Rabh. Alg. Eur. (1868), p. 183.

Euastrum circulare, var. γ, Ralfs. Desm. (1848), p. 85, t. 13, f. 5 *c*.

Hab. In pools.

Westmoreland; France, United States. (?)

Plate XXXIV., fig. 4. *a*, living frond; *b*, empty frond.

Euastrum pectinatum. *Breb. in Ralfs. Desm.* (1848), *p.* 87, *t.* 14, *f.* 5.

Frond rather more than twice as long as broad; segments three-lobed, basal portion subquadrilateral; lateral lobes horizontal, deeply emarginate; end lobe much dilated, straight or slightly concave at ends; angles entire or emarginate; empty frond punctate; front view of semi-cells with three inflations near the base. Zygospore orbicular, tuberculose.

Size. Length 65 μ; diam. 45 μ (R.); zygospore 50-55 μ (R.); length 58-72 μ; diam. 44-48 μ (K.).

Archer in Prit. Inf. (1861), p. 730, t. 2, f. 10 and 30. Cleve Sver. Desm. (1864), p. 486. Lundell Desm. Suec. (1871), p. 17. Nordstedt Norges Desm. (1873), p. 7. Petit Liste Desm. Paris (1877), p. 31. Wittrock Scan. Desm. (1869), p. 8. Brebisson Liste Desm. (1856), p. 123. Notaris Desm. Ital. (1867), p. 37, t. 3, f. 15. Rabh. Alg. Eur. (1868), p. 180. Jacobsen Desm. Denm. (1874), p. 189. Kirchner Alg. Schles. (1878), p. 160.

Euastrum gemmatum, Ralfs. Ann. Nat. Hist. (1844), xiv., p. 191, t. 7, f. 4. Hassall Fr. Alg. (1845), p. 382.

Cosmarium pectinatum, Breb. in Meneg. Syn. Desm. (1840), p. 222.

Hab. In boggy pools.

Sussex, Hants, Cheshire, Westmoreland, Wales, Scotland; France, Germany, Sweden, Norway, Denmark, Italy.

Plate XXXIV., fig. 5. *a*, living frond; *b*, empty frond; *c*, living frond of variety; *d*, empty frond; *e*, zygospore.

Euastrum gemmatum. *Kutz. Phyc. Germ.* (1845), *p.* 134.

Frond scarcely twice as long as broad; segments three-lobed; lateral lobes horizontal, deeply emarginate, the protuberances minutely granulate; end lobe dilated, its dilations inclined upwards and minutely granulate, each end with a deep rounded emargination; empty frond slightly punctate; semi-cells in front view with three granulate inflations near the base; transverse view with three granulate inflations at each side, and one at each end.

Size. Diam. 38 μ (W.); length 55 μ; diam. 37 μ (R.); length 53 μ; diam. 39 μ (D.); length 65-72 μ; diam. 33-43 μ (K.).

Ralfs. Desm. (1848), p. 87, t. 14, f. 4. Jacobsen Desm. Denm. (1874), p. 189. Archer in Prit. Inf. (1861), p. 730. Kirch. Alg. Schles. (1878), p. 160. Delponte Desm. (1876), t. vi., f. 6, 7 (variety). Lundell Desm. Suec. (1871), p. 17. Nordstedt Norges Desm. (1873), p. 7. Wood F. Water U.S. (1872), p. 136. (?) Brebisson Liste Desm. (1856), p. 123. Rabh. Alg. Eur. (1868), p. 180. Wolle Desm. U.S. (1884), p. 101, t. 28, f. 1-2.

Cosmarium gemmatum, Breb. in Meneg. Syn. Desm. (1840), p. 221.

Euastrum (Eucosmium) Hassallianum, Näg. Einz. Alg. (1849), p. 120, t. 7 B.

Hab. In bogs.

Sussex, Westmoreland, Cornwall, Hants, Wales, Scotland; France, Germany, Norway, Sweden, Denmark, Italy, United States.

Plate XXXV., fig. 1. *a c*, living fronds; *b d*, empty fronds; *e*, side view; *f*, end views.

Euastrum rostratum. *Ralfs. Ann. Nat. Hist.* (1844), xiv., *t.* 7, *f.* 5.

Frond scarcely twice as long as broad, oblong; segments with their basal portion deeply emarginate at the sides, connected by a broad neck with the terminal portion; ends protuberant, angular, acutely emarginate at the centre, and having at each side a horizontal subacute projection. Zygospore orbicular, spinulose.

Size. Length 30-50 μ; diam. 25-35 μ (R.); length 50 μ; diam. 35 μ (C.).

Ralfs. Desm. (1848), p. 88, t. 14, f. 6. Archer in Prit. Inf. (1861), p. 730, t. 1, f. 26. Wittrock Scan. Desm. (1869), p. 6. Nordstedt Desm. Spitz. (1872), p. 37. Hassall Fr. Alg. (1845), p. 383. Nordstedt Desm. Arct. (1875), p. 30, 41. Brebisson Liste Desm. (1856), p. 124. Cleve Sver. Desm. (1864), p. 485. Lundell Desm. Suec. (1871), p. 21. Nordstedt Norges Desm. (1873), p. 10. Wolle Desm. U.S. (1884), p. 106, t. 27, f. 8, 9.

Euastrum elegans, var. *β. rostratum*, Rabh. Alg. Eur. (1868), p. 186. Kirch. Alg. Schles. (1878), p. 159. Jacobsen Desm. Denm. (1874), p. 191.

HAB. In pools.

Sussex, Westmoreland, Cornwall, Wales, Scotland; France, Germany, Sweden, Norway, Russian Lapland, Spitzbergen, Denmark, United States.

Plate XXXV., fig. 2. *a c e*, living fronds; *b d f*, empty fronds.

Euastrum elegans. *Breb. in Ralfs. Desm.* (1848), *p.* 89, *t.* 14, *f.* 7.

Frond minute, scarcely twice as long as broad, oblong; segments with their basal portion emarginate at the sides, connected by a broad neck with the terminal portion; ends protuberant, rounded, acutely emarginate at the centre, pouting; side view with an inflation at the base of the segments, sides concave, ends rounded. Zygospore orbicular, spiny.

SIZE. Diam. 18-36 μ (W.); zygospore 25 μ; length 25-50 μ; diam. 17-35 μ (R.)

Archer in Prit. Inf. (1861), p. 730. Nordstedt Desm. Arct. (1875), p. 30. Cleve Sver. Desm. (1864), p. 485. Nordstedt Norges Desm. (1873), p. 10. Petit Liste Desm. Paris (1877), p. 31. Wood F. Water Algæ U.S. (1872), p. 140. Brebisson Liste Desm. (1856), p. 124. Rabh. Alg. Eur. (1868), p. 186 in part. Wolle Desm. U.S. (1884), p. 106, t. 27, f. 10-16; f. 25-26. Wittrock Scan. Desm. (1869), p. 6. Wille Nov. Sem. (1879), p. 32. Nordstedt Desm. Spitz. (1872), p. 37. Jacobsen Desm. Denm. (1874), p. 191 (excl. rostrata). Kirchner Alg. Schles. (1878), p. 159 (partly).

Cosmarium elegans, Breb. in Meneg. Syn. Desm. (1840), p. 222.

Euastrum bidentatum, Näg. Ein. Alg. (1849), t. 7, f. D. 1.

HAB. In pools.

Widely distributed in England, Wales, Scotland; France, Germany, Norway, Spitzbergen, Sweden, Nova Zembla, Denmark, United States.

Plate XXXV., fig. 3. *a*, living frond; *b*, empty frond; *c*, zygospore.

var. *a*. *Ralfs. Desm., p.* 89.

Neck somewhat constricted, end portion bearing on each side an acute horizontal spine-like projection.

Lundell Desm. Suec. (1871), p. 22. Grunow Desm. Austr. (1858), p. 501.

var. γ. **spinosum.** *Ralfs. Desm.* (1848), p. 89, t. 14, f. 7, *f.*

Neck not constricted, lateral projections bearing minute spines directed obliquely outwards.

SIZE. Diam. 35-40 μ (W.).

Euastrum spinosum Hass. Fr. Alg. (1845), p. 384. Wolle Desm. U.S. (1884), p. 106, t. 27, f. 4-7, 17.

Euastrum elegans, var. γ Archer in Prit. Inf. (1861). Lundell Desm. Suec. (1871), p. 22.

Plate XXXV, fig. 5. *a*, living frond; *b*, empty frond; *c, d.*

Euastrum inerme. *Lund. Desm. Suec. p.* 20, *t.* 2, *f.* 3.

Subelliptic, semi-cells subtriangular, apex somewhat protracted, truncate, deeply incised, not dilated or dentate; sides bi-undulate, basal crenation most prominent, obtuse, and angle obliquely truncate; tumors three, inconspicuous and sometimes wanting; end view subelliptic, sides bi-gibbous; side view ovate. Cell membrane finely punctate.

SIZE. Diam. 32-38 μ (W.); length 56 μ; diam. 32-35 μ (L.); length 19-55 μ; diam. 13-36 μ (K.).

Wolle Desm. U.S. (1884), p. 104, t. 29, f. 6, 8; t. 27, f. 30-36. Nordst. Norges Desm. (1873), p. 9.

Euastrum elegans β inerme, Ralfs Desm. (1848), p. 89, t. 14, f. 7 *e*. Notaris Desm. Ital. (1867), p. 37, t. 3, f. 17. Grunow Desm. Austr. (1858), p. 501. Rabh. Alg. Eur. (1868), p. 186. Jacobsen Desm. Denm. (1874), p. 191.

HAB. In pools.

Germany, Sweden, Norway, Denmark, Austria, Italy, United States.

Plate XXXV., fig. 4. *a*, living frond; *b*, empty frond.

Euastrum binale. *Ralfs. Ann. Nat. Hist.* (1844), XIV., *p.* 193, *t.* 7, *f.* 7.

Frond very minute, scarcely twice as long as broad, oblong; segments with their basal portion either entire or bicrenate at the sides, slightly contracted beneath the ends; ends dilated, not protuberant beyond the angles, its central notch acute, broad; transverse view with two lateral inflations, ends truncate, angles rounded.

SIZE. Diam. 15-25 μ (W.); diam. 24 μ (D.).

Ralfs. Desm. (1848), p. 90, t. 14, f. 8. Archer in Prit. Inf. (1861), p. 731, t. 3, f. 13. Delponte Desm. (1876), p. 107, t. vi, f. 9-10. Cleve Sver. Desm. (1864), p. 486. Lundell Desm. Suec. (1871), p. 22. Nordstedt Norges Desm. (1873), p. 10. Wolle Desm. U.S. (1884), p. 107, t. 27, f. 23-24. Petit Liste Desm. Paris (1877), p. 31. Wood. F. Water Algæ U.S. (1872), p. 141. Wittrock Scan. Desm. (1869), p. 7. Brebisson Liste Desm. (1856), p. 124. Notaris Desm. Ital. (1867), p. 37, t. 3, f. 18. Rabh. Alg. Eur. (1868), p. 186. Wille Nova Zembla (1879), p. 32. Nordstedt Desm. Spitz. (1872), p. 37. Jacobsen Desm. Denm. (1874), p. 192. Kirchner Alg. Schles. (1878), p. 159.

Heterocarpella binalis, Turp. Dict. Des. Sci. Nat. (1820).
Cosmarium binale, Meneg. Syn. Desm. (1840), p. 221.
Euastrum lobulatum, Breb. Desm. Norm., p. 124, t. 1, f. 4.
Euastrum dubium, Näg. Einz. Alg. (1849), p. 122, t. 7 D., fig. 2.

HAB. In pools.

Sussex, Hants, Surrey, Westmoreland, Gloucester, Cornwall, Wales, Scotland; France, Germany, Sweden, Norway, Denmark, Nova Zembla, Spitzbergen, Italy, United States.

Plate XXXV., fig. 6. *a c e*, living fronds; *b d f*, empty fronds.

var. β. **denticulatum.** *Kirch. Alg. Schles., p.* 159.

Frond rather larger, rough with a few scattered granules; margins of segments crenate, acute angles of end portion slightly horizontally prolonged, its notch small, rounded.

SIZE. Length 12-29 μ; diam. 10-23 μ (K.).

Euastrum binale, var. γ. Archer in Prit. Inf. (1861), p. 731. Ralfs. Desm. (1848), p. 90, t. 14, f. 8, *f.* Lundell Desm. Suec. (1871), p. 22. Wittrock Scan. Desm. (1869), p. 7.

Plate XXXV., fig. 7. *a*, living frond; *b*, empty frond.

var. **angustatum.** *Wittrock.*

SIZE. Length 25-28 μ; diam. 17-19 μ.

One third longer than broad; segments hexagonal, narrowed at the apex, sides retuse.

Euastrum polare, Nordst. Desm. Spitzb., p. 37, t. 7, f. 24. Jacobsen Desm. Denm. (1874), p. 192.
Euastrum binale, var. *angustatum* Wittr. Sotv. Alg. (1872), p. 50, t. 4, f. 8. Archer Micr. Journ. (1873), xiii, p. 315.
Cosmarium angustatum, Nordst. Desm. Arct. (1875), p. 20.

Nordst. and Wittr. Desm. Ital. (1876), p. 35. Wille Nov. Sem. (1879), p. 39.

Spitzbergen, Nova Zembla.

Plate XXXV., fig. 9. *a b*, living fronds; *c d*, empty fronds.

var. **insulare**. *Wittr. Sotv. Alg.* (1872), *p.* 49, *t.* 4, *f.* 7.

Archer Micr. Journ. (1873), xiii, p. 315.

Euastrum insulare, Wolle. Desm U.S. (1884), p. 104.

Plate XXXV., fig. 10. *a*, living frond; *b*, empty frond; *c*, side view.

var. **elobatum**. *Lund. Desm. Suec. p.* 23, *t.* 2, *f.* 7.

Frond minute, truncately elliptical in outline; semi-cells three-lobed; terminal lobe truncate, gibbous, slightly concave, entire, sutural constriction deep. Each semi-cell with a moderately conspicuous projection in the centre.

SIZE. Length 28 μ; diam. 14 μ (B.).

Euastrum Lundellii, Bennett Roy. Mic. Journ. (1886), p. 1, t. 1, f. 13.

HAB. Amongst *Sphagnum*.

Loughrigg; Sweden.

Plate XXXV., fig. 8. *a*, living frond; *b*, empty frond; *c*, side view.

Euastrum erosum. *Lund. Desm. Suec. t.* II., *f.* 6.

Small, nearly twice as long as broad, deeply constricted, with a narrow linear sinus; semi-cells somewhat hexagonal, a little attenuated about the apex, with a short rounded lobule on the middle of each side; apex subtruncate, slightly emarginate, upper angles obtuse, lower rounded; end view somewhat rectangular, with convex sides, and 3-crenulate ends; side view quadrate, narrowed a little at the truncate and obscurely tridentate ends. Cell membrane smooth.

SIZE. Length 39 μ; diam. 23 μ (L.).

Bennett Roy. Micr. Journ. (1886), p. 1. Wolle Desm. U.S. (1884), p. 104.

HAB. In rain water and pools.

Lake District (England); Sweden.

Plate XXXV., fig. 12. *a*, living frond; *b*, empty frond; *c*, side view; *d*, end view.

Euastrum venustum. *Breb. Liste, p.* 124, *t.* 1, *f.* 3.

Small, a little longer than broad; at each end broadly truncate, outline undulate, semi-cells quadrately reniform, lower angles rounded, sides tri-undulate, centre with an ocellate point. Cell membrane smooth.

SIZE. 40 μ; diam. 29 μ.

Cleve Bidrag (1863), p. 486, No. 15. Lund. Desm. Suec. (1871), p. 23.

Cosmarium venustum, Rabh. Alg. Eur. (1868), p. 164.

HAB. In bog pools.

France, Germany, Sweden.

Plate XXXV., fig. 11. *a*, living frond; *b*, empty frond.

Euastrum ornithocephalum. *Bennett Roy. Micr. Journ.* (1886), *p.* 9, *t.* 1, *f.* 12.

Frond minute. Each semi-cell with a basal and central rounded lobe, and a terminal lobe, moderately deeply divided vertically, and with a single projecting tooth, the lobe resembling a bird's head. Sutural division somewhat shallow. Cell membrane tuberculate.

SIZE. Length 57 μ; diam. 30 μ (B.).

HAB. In bog pools.

Loughrigg (England).

Plate XXXV., fig. 13. *a*, living frond; *b*, empty frond, after Bennett.

Euastrum crenatum. *Kutz. Phyc. Germ.* (1845), 135.

Frond minute, about the size of *E. elegans*; hexagonal in outline; terminal lobe with quite straight extremity, and very slight vertical incision. Each semi-cell with about three shallow crenations on each side. Suture shallow. Cell membrane not punctate.

SIZE. Length 45 μ; diam. 30 μ (B.).

Bennett Roy. Micr. Journ. (1886), p. 9, t. 1, f. 14. Archer in Pritch. Infus. (1861), p. 730.

HAB. Bog pools.

Longhrigg (England); Germany.

Plate XXXV., fig. 14. *a*, living frond; *b*, empty frond.

GENUS 16. COSMOCLADIUM, *Breb.* (1856).

Thallus gelatinous, dichotomously branched, branches springing from the axis or apices of the cells. Cells compressed, elliptical, reniform. Propagation as in *Cosmarium.—Rabh. Alg. Eur.* iii. (1868), p. 53; *DeBary Conjug.* (1858), p. 76.

Cosmocladium saxonicum, *DeBary Conjug.* (1858), *p.* 76.

Not fixed, nestling in a free floating gelatinous mucus, ramifications extending in two or three directions; cells elliptical, with a linear sinus; semi-cells reniform, even, yellowish green, variously attached by the broad side.

SIZE. Cells diam. 12 μ, long 19 μ (Rabh.).

Rabh. Alg. iii. 54. Archer Micro. Journ. 1867, pp. 299.

Cosmocladium pulchellum, Brhn. in Rabh. Exs., 1222.

HAB. In pools.

Lake Elsie, near Bettws-y-coed, in North Wales; Aboyne; Germany.

Plate XXXV. fig. 16. Portion of thallus with separate cell.

Cosmocladium constrictum *(Ar.), Josh. Journ. Bot.* (1883), *p.* 292.

Cells somewhat irregularly figure-of-8 shaped, that is constricted at both sides, the ends tapering in a somewhat triangular manner to the bluntly rounded extremities.

SIZE. Smaller than *C. Saxonicum*, size not indicated.

Dictyosphærium constrictum, Archer in Micro. Journ., 1866, vi., p. 128.

HAB. In pools.

Ireland, Aboyne, Penzance.

GENUS 17. COSMARIUM, *Corda* (1835).

Frond more or less constricted; segments undivided, usually rounded, sometimes slightly sinuated, or rarely slightly contracted, somewhat extended and truncate at the ends, never notched, neither provided with spines nor processes; end view elliptic, and sometimes each side with a lateral opposite inflation, or circular.

A. Frond compressed, central constriction a deep, usually linear, incision, end view compressed, either elliptic, or sub-cruciform, owing to the projection at each side of a protuberance or inflation.

* *Margins of segments entire, neither crenulate nor granulate.*

Cosmarium sublobatum *(Breb.), Pritch. Infus.* (1861), *p.* 731.

Frond scarcely twice as long as broad, oblong, constriction linear, segments subquadrate, somewhat wider at the base, lateral and end margins slightly concave, smooth, transverse view cruciform.

SIZE. Diam. 38-44 μ (W.).

Schaarschm. Magy. Desm. (1882), p. 269. Nordst. & Wittr.

Desm. Ital. (1876), p. 39. Wood F. Water Algæ U.S. (1872), p. 132. Rabh. Alg. Eur. (1868), p. 168. Kirchner. Alg. Schles. (1878), p. 153. Wolle Desm. U.S. (1884), p. 80, t. 18, f. 21, 22. Grunow. Desm. Austr. (1858), p. 501.

Euastrum? sublobatum, Breb. in Ralfs. Desm. (1848), p. 91, t. 32, f. 4. Breb. Liste Desm. (1856), p. 124. Nordstedt Norges Desm. (1873), p. 10.

HAB. In pools.

Westmoreland, Wales; France, Germany, Austria, Italy, Norway, United States.

Plate XXXVI. fig. 1. *a*, living frond; *b*, empty frond; *c*, end views.

Cosmarium quadratum, *Ralfs. Ann. Nat. Hist.* (1844), XIV., *t.* 11, *f.* 9.

Frond about twice as long as broad, constriction deep, linear, segments quadrate, slightly protuberant on each side at the base; with rounded angles at the ends, smooth, end view compressed.

SIZE. Length 50-61 μ; diam. 30-37 μ (Wille); length 59 μ; diam. 33-37 μ (N.).

Nordst. Desm. Greenl. (1885), p. 7. Ralfs. Desm. (1848), p. 92, t. 15, f. 1. Archer in Prit. Inf. (1861), p. 731. Nordstedt Desm. Arct. (1875), pp. 19, 38, 40. Hassall Fr. Alg. (1845), p. 367. Lundell Desm. Suec. (1871), p. 47. Nordstedt Norges Desm. (1873), p. 23. Petit Liste Desm. Paris (1877), p. 30. Grunow Desm. Austr. (1858), p. 501. Brebisson Liste Desm. (1856), p. 126. Rabh. Alg. Eur. (1868), p. 162. Wolle Desm. U.S. (1884), p. 59, t. 18, f. 8-10. Wille Nov. Sem. (1879), p. 37. Nordstedt Desm. Spitz. (1872), p. 29. Kirchner Alg. Schles. (1878), p. 146.

Cosmarium cucumis b. quadratum, Klebs. Desm. Pruss. (1879), p. 30. Jacobsen Desm. Denm. (1874), p. 199.

HAB. In pools.

Kent, Wales, Scotland; France, Spitzbergen, Sweden, Norway, Nova Zembla, Russian Lapland, Greenland, Austria, United States.

Plate XXXVI., fig. 2. *a*, living frond; *b*, empty frond; *c*, side view; *d*, end view.

Cosmarium binerve, *Lundell Desm. Suec.* (1871), *p.* 49, *t.* 3, *f.* 19.

Supposed to be British on the authority of the figure in Hassall's F. W. Algæ, t. 86, fig. 12. Is too doubtful to insert here.

Cosmarium plicatum, *Reinsch. Alg. Fl.* (1867), *p.* 108, *t.* 9, *f.* 1.

Semicells in front view truncate-conoid or almost rectangular, vertical and side views elliptical. Frond in front view not deeply incised at the middle, about twice as long as broad; cell-membrane smooth.

SIZE. Length 30-58 μ; diam. 15-27 μ (Re.).

Barker Micr. Journ. xiii. (1873), p. 435.

HAB. Mountain pools.

Scotland; Germany, Sweden.

Plate XXXVI., fig. 3. *a*, living frond; *b*, empty frond: *c*, side view.

var. **sinuosum,** *Lundell Desm. Suec.* (1871) *p.* 48.

Sides and apex of semicells slightly concave, with angles prominent and rounded, amylaceous granule single.

SIZE. Length 38-45 μ; diam. 18-22 μ (L.).

Nordst. & Wittr. Desm. Ital. (1876), p. 31. Nordstedt Desm. Arct. (1875), p. 38.

Cosmarium quadratum var., Ralfs. Desm., t. xv., f. 1, *c.*

Cosmarium sinuosum, Wille Nov. Sem. (1879), p. 37.

HAB. On rocks.

Ireland; Nova Zembla, Sweden, Italy.

Plate XXXVI., fig. 4. *a*, living frond; *b*, empty frond; *c*, side view.

Cosmarium Hammeri. *Reinsch. Alg. Fl.* (1867), *p.* 111, *t.* x, *f.* 1.

Semi-cells in front view truncately conical, almost trapezoid, terminal margin straight and emarginate, lateral margins more or less simply emarginate, end view regularly elliptic, side view semi-elliptic or almost circular, transverse diameter a little longer than the longitudinal; cell-membrane smooth.

SIZE. Length 45 μ (Re.); diam. 20-24 μ (W.).

var. **Hibernicum.**

About one-third longer than broad, lateral margins of semi-cells concave, upper margins convexo-truncate, in side view rounded, a minute tooth-like protuberance visible just at the suture, in end-view elliptic.—*Archer Micr. Journ.*, xviii. (1877), p. 304.

Crowe Micr. Journ. (1873), xiii., p. 435. Lundell Desm. Suec. (1871), p. 37. Archer Micr. Journ., xvii. (1877), p. 314. Wolle Desm. U.S. (1884), p. 79, t. 18, f. 27, 36, 38. Wille Norges Alg. (1880), p. 32. Nordst. Desm. Greenl. (1885), p. 6. Schaarschm. Magy. Desm. (1882), p. 267.

HAB. On wet rocks.

Ireland, Scotland; Germany, Sweden, Hungary, Greenland, United States.

Plate XXXVI., fig. 5. *a*, living frond; *b*, empty frond; *c*, side view; *d*, end view.

Cosmarium Nymannianum. *Grunow in Rabh. Alg. Eur* (1868), III., *p.* 166.

Frond of medium size, outline somewhat hexagonal, delicately punctate, resembling *C. sublobatum.* Semi-cells rather broader than long, quadrangular, angles obtuse, sides slightly repand, single amylaceous granule in the centre of each semi-cell.

SIZE. Length 44-48 μ ; diam. 33-36 μ (L.) ; length 50 μ ; diam. 36-38 μ (W.).

Nordstedt Norges Desm. (1873), p. 17. Lundell Desm. Suec. (1871), p. 36, t. 3, f. 1. Archer in Journ. Bot. (1874), iii., 93. Wolle Desm. U.S. (1884), p. 79. Wille Norges Alg. (1880), p. 32. Lemaire Desm. Vosg. (1883), p. 20.

HAB. In bogs.

Lake District, Hants, Cornwall, Ireland ; France, Germany, Sweden, Norway, United Sates.

Plate XXXVI., fig. 6. *a*, living frond; *b*, empty frond.

Cosmarium homalodermum. *Nordst. Desm. Arct.* (1875), *p.* 18, *t.* 6, *f.* 4.

Medium size, about a fifth part longer than broad, deeply constricted, with a linear sinus, widened at the extremity, semi-cells trapezoid from a somewhat reniform base, narrowed upwards, side straight or rather retuse, dorsal margin truncate or often a little retuse, upper angles obtuse, lower broadly rounded, end view elliptic-oblong, a little swollen in the middle, side view ovate, membrane very delicately or indistinctly punctate.

SIZE. Length 54-66 μ ; diam. 48-51 μ (N.) ; diam. 40 μ (W.).

Wolle Desm. U.S. (1884), p. 81, t. 17, f. 19, 20. Nordst. & Wittr. Ital. (1876), p. 34. Lemaire Desm. Vosg. (1883), p. 20.

Cosmarium pyramidatum, forma *intermedia*, Nordst. Norg. Desm. (1873), p. 19.

HAB. In ponds.

France, Spitzbergen, Norway, United States.

Plate XXXVI., fig. 7. *a*, living frond; *b*, empty frond; *c*, end view ; *d*, side view.

Cosmarium anceps. *Lund. Desm. Suec.* (1871), *p.* 48, *t.* 3, *f.* 4.

Small, twice as long as broad, oblong, hexagonal, not deeply constricted, with a narrow linear sinus ; in side view oblong, slightly emarginate in the middle, and rounded at the poles ; semi-cells sub-quadrate, attenuated gradually from the base, truncate at the apex, and very slightly emarginate, sides straight, end view somewhat circular; cell-membrane smooth; amylaceous granule single.

SIZE. Length 32-35 μ; diam. 17-18 μ (L.); length 45-50 μ; diam. 17-18 μ (W.); length 24 μ; diam. 12 μ (Wille); length 25-33 μ; diam. 15-20 μ (N.).

Lundell Desm. Suec. (1871), p. 48, t. 3, f. 4. Nordstedt Desm. Greenl. (1885), p. 7. Archer Micr. Journ. (1875), xv., p. 409. Nordstedt Norges Desm. (1873), p. 24. Nordstedt Desm. Arct. (1875), p. 19, 38. Nordst. & Wittr. Desm. Ital. (1876), p. 35. Wille Nov. Sem. (1879), p. 39. Nordstedt Desm. Spitz. (1872), p. 36. Wolle Desm. U.S. (1884), p. 59, t. 18, f. 11.

HAB. In ponds.

Scotland, Ireland; Spitzbergen, Nova Zembla, Norway, Sweden, Italy, Greenland, United States.

Plate XXXVI., fig. 8. *a,* living frond; *b,* empty frond; *c,* side view; *d,* end view.

Cosmarium granatum. *Breb. in Ralfs. Desm.* (1848), *p.* 96, *t.* 32, *f.* 6.

Frond minute, somewhat longer than broad, constriction linear; segments broader than long, rapidly tapering, truncate-triangular, smooth. Side view compressed, end view elliptic.

SIZE. Length 21 μ; diam. 18 μ (D.); diam. 20-32 μ (W.).

Lemaire Desm. Vosg. (1883), p. 21. Schaarschm. Magy. Desm. (1882), p. 269. Nordstedt Desm. Greenl. (1885), p. 7. Wille Norges Alg. (1880), p. 35. Wittr. Sottvat Alg. (1872), p. 61. Archer in Prit. Inf. (1861), p. 732. Delponte Desm. (1878), p. 4, t. 7, f, 16-21. Nordstedt Desm. Arct. (1875), p. 19, 38. Cleve Sver. Desm. (1864), p. 488. Lundell Desm. Suec. (1871), p. 42. Nordstedt Norges Desm. (1873), p. 19. Petit Liste Desm. Paris (1875), p. 30. Grunow Austr. Desm. (1858), p. 497. Nordst. & Wittr. Desm. Ital. (1876), p. 32. Nordstedt Desm. Spitz. (1872), p. 29. Wolle Desm. U.S. (1884), p. 60, t. 50, f. 13, t. 15, f. 14, 15. Wittrock Scan. Desm. (1869), p. 12. Brebisson Liste Desm. (1856), p. 126. Rabh. Alg. Eur. (1868), p. 162. Wille Nov. Sem. (1879), p. 38. Jacobsen Desm. Denm. (1874), p. 198. Kirchner Alg. Schles. (1878), p. 147.

Cosmarium granatum a typicum, Klebs. Desm. Pruss. (1879), p. 32.

HAB. In quiet water.

Gloucester, Cornwall, Wales; France, Germany, Sweden, Denmark, Norway, Spitzbergen, Nova Zembla, Austria, Italy, Hungary, Greenland, United States.

Plate XXXVI., fig. 9. *a*, living frond; *b*, empty frond.

Cosmarium variolatum. *Lund. Desm. Suec.* (1871), *p.* 41, *t.* 2, *f.* 19.

Small, two-thirds longer than broad, elliptic, with a deep median incision, sinus linear, very narrow, semi-cells narrowed more and more from the base, rounded at the apex, but at the middle of the apex a little depressed, side slightly convex; end view broadly elliptic; side view obovate. Cell-membrane subpustulate; amylaceous granule single.

SIZE. Length 32-35 μ; diam. 19-21 μ (L.); diam. 15-17 μ (W.).

Nordstedt Norges Desm. (1873), p. 19. Archer in Journ. Bot. (1874), iii., 93. Wolle Desm. U.S. (1884), p. 63, t. 16, f. 3, 4. Wille Norges Desm. (1880), p. 35.

HAB. In ponds.

Lake District; Ireland; Norway, Sweden, United States.

Plate XXXVI., fig. 10. *a*, living frond; *b*, empty frond; *c*, side view; *d*, end view.

Cosmarium cucumis. *Corda Alm. Carls.* (1835), *f.* 27.

Frond about twice as long as broad; constriction deep, linear; segments as broad as long, with the basal angles rounded, broadly rounded at ends, smooth; end view elliptic.

SIZE. Diam. 46-56 μ (W.); length 70 μ; diam. 38 μ (N.); length 36-68 μ; diam. 36-38 μ (N.).

Schaarschm. Magy. Desm. (1882), p. 269. Ralfs. Desm. (1848), p. 93, t. 15, f. 2. Nordstedt Desm. Greenl. (1885), p. 9. Archer in Prit. Inf. (1861), p. 731. Nordstedt Desm. Arct. (1875), p. 29. Nordst. Desm. Braz. (1869), p. 210. Cleve Sver. Desm. (1864), p. 487. Lundell Desm. Suec. (1871), p. 52. Nordstedt Norges Desm. (1873), p. 25. Petit Desm. Paris (1877), p. 30. Lemaire Desm. Vosg. (1883), p. 22. Grunow Desm. Austr. (1858), p. 501. Wolle Desm. U.S. (1884), p. 58, t. 15, f. 6-9. Wille Norges Alg. (1880), p. 38. Wood F. Water Algæ U.S. (1872), p. 130. Brebisson Liste Desm. (1856), p. 126. Notaris Desm. Ital. (1867), p. 40, t. 3, f. 21. Rabh. Alg. Eur. (1868), p. 161. Wille Nov. Sem. (1879), p. 48. Nordstedt Desm. Spitz. (1872), p. 36. Jacobsen Desm. Denm. (1874), p. 199 (partly). Kirchner Alg. Schles. (1878), p. 146.

Euastrum integerrimum, Ehr. Inf. (1838), p. 163, t. 12, f. 9.

Cosmarium cucumis a typicum, Klebs. Desm. Pruss. (1879), p. 30.

HAB. In pools.

Sussex, Gloucester, Cornwall, Westmoreland, Wales, Scotland; France, Germany, Austria, Hungary, Italy, Sweden, Norway, Denmark, Spitzbergen, Nova Zembla, Greenland, United States, Brazil.

Plate XXXVI., fig. 11. *a*, living frond; *b*, empty frond; *c*, end view.

Cosmarium Ralfsii. *Breb. in Ralfs. Desm.* (1848), *p.* 93, *t.* 15, *f.* 3.

Frond large, slightly longer than broad, orbicular; constriction deep, linear; segments semi-orbicular, rounded at basal angles, smooth; end view elliptic-lanceolate; endochrome radiate.

SIZE. Length 70-120 μ; diam. 60-100 μ (W.).

Breb. Liste Desm. (1856), p. 126. Archer in Prit. Inf. (1861), p. 731. Lundell Desm. Suec. (1871), p. 52. Nordstedt Norges Desm. (1873), p. 25. Rabh. Alg. Eur. (1868), p. 161. Wolle Desm. U.S. (1884), p. 69, t. 15, f. 1. Lemaire Desm. Vosg. (1883), p. 22.

Cosmarium cucumis, Hassall Fr. W. Alg. (1845), p. 366. Ralfs. Ann. Nat. Hist. (1844), xiv., t. 11, f. 8.

Cosmarium Ralfsii a typicum, Klebs. Desm. Pruss. (1879), p. 33.

HAB. In boggy waters.

Kent, Sussex, Hants, Norfolk, Warwick, Wales, Scotland; France, Germany, Norway, Sweden, United States.

Plate XXXVI., fig. 12. *a*, living frond; *b*, empty frond; *c*, end view.

Cosmarium pachydermum. *Lundell Desm. Suec.* (1871), *p.* 39, *t.* 2, *f.* 15.

Large, a third part longer than broad, deeply constricted, with a narrow linear sinus; semi-cells semi-circular, forming two-thirds of a circle, lower angles rounded; end view oval; side view elliptically orbicular, cell-membrane thick, distinctly but densely punctate. Amylaceous granules two.

SIZE. Length 105-117 μ; diam. 80-87 μ (L.).; diam. 75-100 μ (W.).

Wolle Desm. U.S. (1884), p. 70, t. 15, f. 2, 3. Wille Norges Desm. (1880), p. 33. Nordstedt & Wittr. Ital. (1876), p. 31. Schaarschm. Magy. Desm. (1882), p. 268. Jacobsen Desm. Denm. (1872), p. 200. Lemaire Desm. Vosg. (1883), p. 21.

HAB. In lakes and ponds.

Lake District, Scotland; France, Denmark, Sweden, Hungary, Italy, United States.

Plate XXXVII., fig. 1. *a*, living frond; *b*, side view; *c*, end view.

Cosmarium pyramidatum. *Breb. in Ralfs. Desm* (1848), *p.* 94, *t.* 15, *f.* 4.

Frond scarcely twice as long as broad, suboval, constriction deep, linear; segments pyramidal, rounded at basal angles, somewhat truncate at the ends, punctate; end view broadly elliptic. Zygospore orbicular, tuberculate.

SIZE. Length 79 μ; diam. 46 μ (D.); diam. 50-85 μ (W.); length 43-66 μ; diam. 26-43 μ (N.).

Breb. Liste Desm. (1856), p. 126. Wille Norges Alg. (1880), p. 35. Nordst. Desm. Bras. (1869), p. 210. Archer in Prit. Inf. (1861), p. 731, t. 3, f. 14, 15. Delponte Desm. (1878), t. 9, f. 30-33. Cleve Sver. Desm. (1864), p. 487. Lundell Desm. Suec. (1871), p. 41. Wolle Desm. U.S. (1884), p. 69, t. 14, f. 16, 17. Nordstedt Norges Desm. (1873), p. 18. Petit Liste Desm. Paris (1877), p. 30. Grunow Desm. Austr. (1858), p. 501. Wood F. Water Algæ U.S. (1872), p. 130. Wittrock Scan. Desm. (1869), p. 10. Notaris Desm. Ital. (1867), p. 40, t. 3, f. 22, 23. Rabh. Alg. Eur. (1868), p. 162. Jacobsen Desm. Denm. (1874), p. 199 (partly). Kirchner Alg. Schles. (1878), p. 149. Schaarschm. Magy. Desm. (1882), p. 268. Lemaire Desm. Vosg. (1883), p. 21.

Pithiscus angulosus, Kutz. Phy. Germ. (1845), p. 129.

Cosmarium ovale, Ralfs. Ann. Nat. Hist. (1844), xiv., p. 394 (partly), t. 11, f. 7, *a*, *b*, *c*.

Cosmarium pyramidatum b typicum, Klebs. Desm. Pruss. (1879), p. 31.

HAB. In pools.

Kent, Sussex, Surrey, Cheshire, Westmoreland, Lancashire, Cornwall, Wales, Scotland; France, Germany, Sweden, Norway, Denmark, Austria, Italy, Hungary, United States, Brazil.

Plate XXXVI., fig. 13. *a*, living frond; *b*, empty frond; *c*, side view; *d*, end view.

Cosmarium pseudopyramidatum. *Lund. Desm. Suec.* (1871), *p.* 41, *t.* 2, *f.* 18.

With the habit of *C. pyramidatum*, but much smaller; membrane delicately punctate, amylaceous granule single.

SIZE. Length 44 μ; diam. 28 μ (L.); length 50 μ; diam. 33 μ (N.).

Nordst. Norges Desm. (1873), p. 19. Nordst. Desm. Arct. (1875), p. 19, 38. Wittrock Sottvat Alg. (1872), p. 60. Archer in Journ. Bot. (1874), iii., 93. Nordst. & Wittr. Desm. Ital. (1876), p. 32. Nordstedt Desm. Spitz. (1872),

p. 29. Wolle Desm. U.S. (1884), p. 69, t. 15, f. 11, 12. Wille Norges Alg. (1880), p. 34. Schaarschm. Magy. Desm. (1882), p. 268.

Cosmarium pyramidatum β minus, Reinsch. in Rabh. Alg. Eur. No. 1902. Jacobsen Desm. Denm. (1874), p. 199.

Cosmarium pyramidatum, Ralfs. Desm. (in part), t. 15, fig. 4, *d*, *e*, *f*.

HAB. Mountain pools.

Lake District, Ireland ; Sweden, Norway, Italy, Hungary, Spitzbergen, Nova Zembla, United States.

Plate XXXVII., fig. 2. *a*, living frond ; *b*, empty frond ; *c*, side view ; *d*, end view.

Cosmarium galeritum. *Nord. Desm. Brazil* (1869), *p.* 209, *t.* 3, *f.* 26.

Medium size, somewhat orbicular, about one third part longer than broad, with a linear sinus, widened at the extremity ; semi-cells semi-orbicular, dorsal margin rounded-truncate, sides very slightly convex or straight, lower angles obtuse, end view elliptic, side view circular.

SIZE. Length 51-54 μ ; diam. 42-45 μ (N.) ; diam. 40-55 μ (W.).

Wolle Desm. U.S. (1884), p. 70, t. 16, f. 46-48. Wille Norges Alg. (1880), p. 35. Nordstedt Alg. Brazil (1877), p. 20.

HAB. In springs and ponds.

North Wales ; Brazil, United States.

Plate XLII., fig. 14. *a*, living frond ; *b*, empty frond ; *c*, side view ; *d*, end view.

Cosmarium pseudonitidulum. *Nordst. Norges Desm.* (1873), *p.* 16, *t.* 1, *f.* 4.

Medium size, with the habit of *C. nitidulum ;* one fourth part longer than broad, deeply constricted with a narrow linear sinus, widened at the extremity ; semi-cells somewhat trapezoid, attenuated from the broad base to the rounded truncate apex, lower angles rounded, end view elliptic, side view ovate-circular, membrane punctate.

SIZE. Length 42 μ ; diam. 33 μ (N.) ; diam. 38 μ (W.).

Cooke in Quekett Journal (1880), p. 211, t. 13, fig. 1, a, b. Wolle Desm. U.S. (1884), p. 62, t. 18, f. 19. Wille Norges Alg. (1880), p. 33.

var. **obsoletum.**

Semi-cells more rounded than in the type.

HAB. In ponds.

North Wales; Norway, United States.

Plate XLII., fig. 15. *a*, living frond; *b*, empty frond; *c*, end view; *d*, side view.

Cosmarium phaseolus. *Breb. in Meneg. Desm.* (1840), *p.* 220.

. Frond in front view about as long as broad, constriction deep, linear; segments reniform, smooth, end view elliptic, with a slight conical projection at each side.

SIZE. Length 30 μ; diam. 33 μ.

Ralfs. Desm. (1848), p. 106, t. 32, f. 5. Archer in Prit. Inf. (1861), p. 732. Nordstedt Desm. Arct. (1875), p. 24. Cleve Sver. Desm. (1864), p. 488. Nordstedt Norges Desm. (1873), p. 17. Petit Liste Desm. Paris (1877), p. 30. Wittrock Scan. Desm. (1869), p. 14. Brebisson Liste Desm. (1856), p. 131. Rabh. Alg. Eur. (1868), p. 166. Jacobsen Desm. Denm. (1874), p. 200. Wolle Desm. U.S. (1884), p. 81, t. 18, f. 28-32. Wille Norges Desm. (1880), p. 35. Schaarschm. Magy. Desm. (1882), p. 270. Lemaire Desm. Vosg. (1883), p. 20. Kirchner Alg. Schles. (1878), p. 152.

Euastrum depressum, Nag.? Einz. Alg. t. vii, cf. 2.

Cosmarium phaseolus a typicum, Klebs. Desm. Pruss. (1879), p. 35.

HAB. In pools.

Cornwall, Westmoreland, Wales; Germany, Sweden, Norway, Denmark, France, Spitzbergen, Hungary, United States.

Plate XXXVII., fig. 3. *a*, living frond; *b*, empty frond; *c*, end view.

Cosmarium gotlandicum. *Wittr. Sotv. Alg.* (1872), *p.* 60, *t.* 4, *f.* 14.

Frond rather longer than broad, constriction linear; segments in front view somewhat hexagonal, or angularly reniform; side view obovate, end view sub-elliptic. Empty frond delicately punctate.

SIZE. Length 37-45 μ; diam. 32-36 μ (W.).

Nordstedt Norges Desm. (1873), p. 19. Archer in Journ. Bot. (1874), iii., p. 93. Wille Norges Alg. (1880), p. 31.

Cosmarium rectangulare, Grunow. Rabh. Alg. Eur. iii., p. 166.

HAB. In ponds and pools.

Cornwall, Ireland; Norway, Sweden, Austria.

Plate XXXVII., fig. 4. *a*, living frond; *b*, empty frond; *c*, side view; *d*, end view.

Cosmarium Trafalgaricum. *Wittr. in Nord. & Wittr. Alg. Exs. No.* 81.

Small, a fifth part longer than broad; deeply constricted in the middle, with a linear sinus, expanding at the extremity; semi-cells in front view reniform, dorsal margin slightly emarginate in the middle; side view orbicular, furnished with a small median tubercle; end view elliptic, with a small median tubercle on each side.

SIZE. Length 24-26 μ; diam. 20-21 μ (W.).

Grevillea, Vol. ix. (1880), p. 16.

HAB. In the fountains, Trafalgar Square, London.

Plate XLIII., fig. 7. *a a*, living fronds; *b b*, empty fronds; *c*, end view; *d*, side view.

Cosmarium tetrachondrium. *Lundell Desm. Suec.* (1871), *p.* 38, *t.* 3, *f.* 2.

Small, a little broader than long, deeply constricted, with a very narrow linear sinus; semi-cells semi-elliptic, scarce 2½ times broader than long; plane at the base, truncato-convex at the apex, rounded at the sides, with two granules at the isthmus; end view elliptic oblong, with two granules on each side; side view circular, with a granule at the base on each side. Amylaceous granule single.

SIZE. Length 20½ μ; diam. 23-26 μ (L.).

Archer Micr. Journ. (1873), xiii., p. 315. Nordstedt Norges Desm. (1873), p. 17. Jacobsen Desm. Denm. (1874), p. 194. Wille Norges Alg. (1880), p. 37.

HAB. In pools.

Ireland; Sweden, Norway, Denmark.

Plate XXXVII., fig. 5. *a*, living frond; *b*, empty fronds; *c*, side view; *d*, end view.

Cosmarium bioculatum. *Breb. in Ralfs. Desm.* (1848), *p.* 95, *t.* 15, *f.* 5.

Frond minute, about as long as broad; constriction deep, producing a gaping notch at each side; segments about twice as broad as long, elliptic, smooth; side view compressed, end view elliptic. Zygospore orbicular, with conical spines.

SIZE. Length 17 μ; diam. 15-16 μ (W.); length 28 μ; diam. 25 μ (N.).

Schaarschm. Magy. Desm. (1882), p. 270. Archer in Prit. Inf. (1861), 731. Wille Norges Alg. (1880), p. 35. Nordstedt Desm. Arct. (1875), p. 20, t. 6, f. 8 (not fig. 9). Cleve Sver. Desm. (1864), p. 488. Lundell Desm. Suec.

(1871), p. 44. Nordstedt Norges Desm. (1873), p. 21. Grunow Desm. Austr. (1858), p. 501. Wood F. Water Algæ U.S. (1872), p. 131. Wolle Desm. U.S. (1884), p. 60, t. 15, f. 21, 22. Brebisson Liste Desm. (1856), p. 126. Rabh. Alg. Eur. (1868), p. 163 (sine var. *b*). Wille Nov. Sem. (1879), p. 44. Nordstedt Desm. Spitz. (1872), p. 29. Kirchner Alg. Schles. (1878), p. 147. Lemaire Desm. Vosg. (1883), p. 21.

Heterocarpella bioculata, Breb. Alg. Fal. (1835), p. 56, t. 7. *Cosmarium Phaseolus b. bioculatum*, Klebs. Desm. Pruss. (1879), p. 35.

HAB. In ponds, ditches, &c.

Widely distributed through England, Wales, Scotland; France, Germany, Norway, Spitzbergen, Sweden, Nova Zembla, Hungary, United States.

Plate XXXVII., fig. 6. *a*, living frond; *b*, empty frond; *c*, side view; *d*, end view; *e*, zygospore.

Cosmarium tinctum. *Ralfs. Desm.* (1848), *p.* 95, *t.* 32, *f.* 7.

Frond very minute, about as long as broad, constriction producing an acute notch at each side; segments elliptic, about twice as broad as long, smooth; end view narrow, elliptic. Empty frond somewhat reddish; zygospore quadrate, smooth.

SIZE. Diam. 10-15 μ (W.); length 12 μ; diam. 10 μ (Wille.)

Kirch. Alg. Schles. (1878), p. 148. Archer in Prit. Inf. (1861), p. 731. Lundell Desm. Suec. (1871), p. 44. Nordstedt Norges Desm. (1873), 21. Grunow Desm. Austr. (1858), p. 498. Nordst. & Wittr. Desm. Ital. (1876), p. 35. Brebisson Liste Desm. (1856), p. 127. Wille Norges. Alg. (1872), p. 36. Wille Nov. Sem. (1879), p. 44. Klebs. Desm. Pruss. (1879), p. 36, t. 3, fig. 45. Jacobsen Desm. Denm. (1874), p. 200. Wolle Desm. U.S. (1884), p. 61, t. 16, f. 31. Schaarschm. Magy. Desm. (1882), p. 270. Lemaire Desm. Vosg. (1883), p. 21.

Sphærozosma tinctum, Rabh. Alg. Eur. (1868), p. 150. Petit Liste Desm. Paris (1877), p. 29.

HAB. In ditches, ponds, &c.

Sussex, Cornwall, Wales; France, Germany, Sweden, Norway, Denmark, Austria, Italy, United States.

Plate XXXVII., fig. 7. *a*, living fronds; *b*, empty fronds; *c*, side view; *d*, zygospore in various stages.

Cosmarium pygmæum. *Archer Micr. Journ.* (1864), IV., *p.* 174, *t.* 6, *f.* 45-49.

Frond very minute, smooth, rather broader than long, segments sub-quadrilateral; end view sub-elliptic, somewhat inflated at each side at the centre. Zygospore rather large, smooth.

SIZE. Length 8-10 μ; diam. 10-12 μ (A.); length 9-12 μ; diam. 11-13 μ (W.).

Lundell Desm. Suec. (1871), 43. Nordstedt Norges Desm. (1873), p. 20. Jacobsen Desm. Denm. (1874), p. 198. Wittrock Sottvat Alg. (1872), p. 61. Lemaire Desm. Vosg. (1883), p. 21.

Sphærozosma pygmæum, Rabh. Alg. Eur. (1868), p. 150. Wittrock Scan. Desm. (1869), p. 26.

HAB. On submerged plants and *Sphagnum*.

Lake District, Ireland; France, Sweden, Norway, Denmark.

Plate XXXVII., fig. 8. *a,* living frond; *b,* empty frond; *c,* side view; *d,* end view; *e,* zygospore.

Cosmarium truncatellum. *Perty. Lebensf.* (1848), *p.* 209, *t.* 16, *f.* 13.

Small, broader than long, with a very narrow sinus, at each pole broadly truncate; semi-cells transversely oblong-hexagonal, plane at the base broadly truncate above, sides angular, end view elliptic. Cell membrane smooth. Zygospore small, orbicular, thickly beset with minute conical spines.

SIZE. Length 12 μ; diam. 18 μ.

Archer Micr. Journ. xiii. (1873), p. 99. Nordstedt Norges Desm. (1873), p. 17. Rabh. Alg. Eur. (1868), p. 165.

Euastrum truncatellum, Perty. Lebensf. (1848), p. 209.

HAB. In mountain pools.

Ireland; Germany, Switzerland, Norway.

Plate XXXVII., fig. 9. *a,* living frond; *b,* empty frond; *c,* end view; *d,* side view; *e,* zygospore.

Cosmarium minutissimum. *Archer Quart. Journ. Micr. Sci.* XVII. (1877), *p.* 194.

Very minute, resembling *Sphærozosma excavatum*, but more minute, and with the sinus a narrow incision. Zygospore ellipsoidal or oblong, of a purplish, or bronze-like hue, with thick walls.

SIZE.

Sphærozosma excavatum, Nordst. *fide* Archer in Quart. Journ. Mic. Sci. xvii. (1877), p. 301.

HAB. In mountain pools.

Ireland; Italy.

Cosmarium tenue. *Archer Micr. Journ.* (1868), VIII., *p.* 293.

Minute, semi-cells elliptic, constriction deep and linear, end view elliptic. Cell membrane smooth. Zygospore globose, smooth (quite destitute of spines).

SIZE. No dimensions given. Larger than *C. tinctum.*

HAB. In pools.

Ireland.

Cosmarium lasiosporum. *Arch. Micr. Journ.* XIX. (1879), *p.* 123.

Very minute (scarcely so large as *C. tinctum*). Sinus linear. Semi-cells flattened at the apex. Zygospore globose, beset with extremely minute fine and pointed spines.

SIZE. (Not stated).

HAB. In pools.

Ireland.

Cosmarium exiguum. *Archer Micr. Journ.* (1864), IV., *p.* 178, *t.* 6, *figs.* 32-33.

Frond very minute, smooth, oblong, rather more than twice as long as broad; segments sub-quadrate; starch granule single central.

SIZE. Length 25 μ; diam 12 μ (A.).

Lundell Desm. Suec. (1871), p. 43. Rabh. Alg. Eur. (1868), p. 164. Wille Norges. Alg. (1880), p. 31, t. 1, f. 14.

HAB. In pools.

Ireland; Scotland.

Plate XLIII., fig. 4. *a a*, living fronds; *b b*, empty fronds; *c*, side view.

Cosmarium Schliephackianum. *Grunow in Rabh. Alg. Eur.* (1868), *p.* 167.

Minute, outline sub-quadrate, broader than long, even deeply-constricted. Semi-cells furnished with a small basal tumour, depressed, broadly truncate above or plano-convex, angles and sides rounded.

SIZE. Diam 12 μ (W.).

Archer in Micr. Journ. (1876), XVI., p. 338. Wille Nov. Sem. (1879), p. 46. Kirchner Alg. Schles. (1878), p. 153. Wolle Desm. U.S. (1884), p. 82, t. 18. f. 14, 15.

var. **Spitzbergensis.** *Nordst. Desm. Arct.* (1875), *p.* 24, *t.* 7, *f.* 15.

HAB. Amongst *Sphagnum.*

Scotland, Ireland; Spitzbergen, Nova Zembla, United States.

Plate XXXVII., fig. 10. *a*, living frond; *b*, empty frond; *c*, side view; *d*, zygospore; *e*, end view; *f*, side view.

*** Margins of segments crenate or slightly undulate, surface not granulate.*

Cosmarium Meneghinii. *Breb. in Ralfs. Desm.* (1848), *p.* 96, *t.* XV., *f.* 6.

Frond very minute, rather longer than broad ; constriction linear ; segments subquadrate, bicrenate at the sides and ends ; smooth, end view elliptic.

SIZE. Length 18 μ ; diam. 14 μ (D.) ; length 24-34 μ ; diam. 20-22 μ (K.) ; diam. 20-22 μ (W.).

Wittr. Sottv. Alg. (1872), p. 59. Archer in Prit. Inf. (1861), p. 732. De Bary Conjug. (1858), p. 72, t. 7, f. 35-46. Delponte Desm. (1878), p. 2, t. 7, f. 5-9. Cleve Sver. Desm. (1864), p. 488. Wille Norges Desm. (1880), p. 30. Lundell Desm. Suec. (1871), p. 43. Nordstedt Norges Desm. (1873), p. 20. Nordstedt Desm. Arct. (1875), p. 40. Petit Liste Desm. Paris (1877), p. 30. Wood F. Water Algæ U.S. (1872), p. 131. Wolle Desm. U.S. (1884), p. 65, t. 16, f. 2. Wittrock Scan. Desm. (1869), p. 12. Brebisson Liste Desm. (1856), p. 127. Rabh. Alg. Eur. (1868), p. 163. Wille Nov. Sem. (1879), p. 43. Jacobsen Desm. Denm. (1874), p. 197. Kirchner Alg. Schles. (1878), p. 148. Schaarschm. Bosn. Serv. (1883), p. 7. Schaarschm. Magy. Desm. (1882), p. 270.

Cosmarium bioculatum, Meneg. Syn. Desm. (1840), p. 220.

Euastrum crenulatum, Näg. Einz. Alg. (1849), t. 7A, f. 7*a-d*. De Not. Desm. Ital. (1867), t. 3, f. 25.

HAB. In pools.

Cornwall, Lake District, Sussex, Hants, Kent, Surrey, North Wales ; France, Germany, Italy, Norway, Sweden, Hungary, Russian Lapland, Nova Zembla, United States.

Plate XXXVII., fig. 11. *a*, living fronds; *b*, empty fronds; *c*, end view.

Cosmarium angulosum. *Breb. Liste, p.* 127, *t.* 1, *f.* 17.

Frond minute, rather longer than broad, constricted in the middle, with a linear sinus ; segments quadrate ; angles rather obtuse.

SIZE. Length 28 μ ; diam. 18 μ (K.).

Euastrum angulosum, Breb. Liste (1856), p. 127.

Cosmarium Meneghinii v. angulosum, Kirchn. Alg. Schles., p. 148. Rabh. Alg. Eur., III., 163. Wolle Desm. U.S. (1884), p. 65. Lund. Desm. Suec. (1871), p. 43. Wille Norges Desm. (1880), p. 30. Wittr. Sottv. Alg. (1872), p. 59.

Hab. In stagnant water.

Lake District; France, Germany, Sweden, Norway, United States.

Plate XLII., fig. 18. *a*, living frond; *b*, empty frond.

Cosmarium obliquum. *Nordst. Norg. Desm.*, 23, *t.* 1, *f.* 8.

Small, about one-quarter longer than broad, rectangular, constricted in the middle, with a linear sinus; side view rectangular, very slightly constricted in the middle; semi-cells subquadrate, truncate at the apex, and slightly emarginate; sides retuse, end view semi-circular, oblique, one side flat, the other convex; cell membrane slightly punctate.

Size. Length 23-26 μ; diam. 18-20 μ (major); 18 × 13 μ (media); 15 × 11 μ (minor).

Wille Nova Zembla, p. 39. Wille Norges Desm. (1880), p. 31. Schaarschm. Magy. Desm. (1882), p. 267.

Hab. In pools.

Scotland; Norway, Nova Zembla, Hungary.

Plate XLIII., fig. 5. *a*, living frond; *b*, empty frond.

Cosmarium læve. *Rabh. Alg. Eur.*, III., 161.

Fronds one and one-third to one and two-thirds longer than broad, constriction deep; constriction narrow, linear; semi-cells with high-rounded ends, usually somewhat retuse; cell membrane finely granular.

Size. Diam. 14-16 μ (W.); length 20-26 μ; diam. 14-17 μ (N. & W.).

Wolle Desm. U.S. (1884), p. 62, t. 15, f. 10. Wille Norges Desm. (1880), p. 31. Nordst. & Wittr. Desm. Ital. (1876), p. 28. Schaarschm. Magy. Desm. (1882), p. 269.

var. **septentrionale.** *Wille Nova Zembla* (1879), *p.* 43, *t.* 12, *f.* 34.

A broader form; semi-cells in side view ovately circular.

Size. Length 28 μ; diam. 22 μ (Wi.).

Hab. On dripping rocks, and in small pools.

Holloway (London), North Wales, Cornwall; France, Germany, Norway, Italy, Hungary, United States.

Plate XLII., fig. 17. *a*, living frond; *b*, *c*, empty fronds; *c*, end view; *d*, side view.

Cosmarium calcareum. *Wittr. Sötv. Alg., p.* 58, *t.* 4, *f.* 13.

Small. Frond but slightly longer than broad, constriction deep, linear; segments in front view semi-circular, rather truncate above, minutely crenulate; side view ovate, end view

elliptic, swollen in the middle; empty frond slightly granulate, with a circular cluster of nine small warts at the base of each segment (eight in circumference and one in the centre).

SIZE. 19-21 × 17-18 μ (Witt.).

Nordst. Norges Desm. (1873), p. 15. Wille Norges Desm. (1880), p. 28. Archer in Journ. Bot. (1874), iii., p. 93.

HAB. Mountain pools.

Ireland; Sweden, Norway.

Plate XXXVII., fig. 12. *a*, living frond; *b*, empty frond; *c*, side view; *d*, end view.

Cosmarium Regnesii. *Reinsch. Alg. Flora* (1867), *p.* 112, *t.* 8, *f.* 8.

Small. Cells in front view rectangular, with a median semi-elliptic incision on each side; semi-cells in front view trapezoid, denticulate at the margin, with eight equi-distant teeth; membrane smooth.

SIZE. Length 11-13 μ; diam. 11-13 μ (Re.).

HAB. In mountain pools.

Germany.

Plate XLII., fig. 19. *a*, living frond; *b*, empty frond; *c*, same magn., 1000 diam.

Cosmarium crenatum. *Ralfs. Ann. Nat. Hist.* (1844), XIV., *t.* 2, *f.* 6.

Frond minute, not quite twice as long as broad, constriction linear; segments obsoletely quadrate, crenate at the margin, flattened at ends, surface punctate; end view elliptic. Zygospore orbicular, spinous; spines short and stout, swollen at the base, and divided at the apex.

SIZE. Length 21 μ; diam. 16 μ (D.); length 53-58 μ; diam. 38 μ (K.); diam. 30-38 μ (W.).

Euastrum ? sinuosum, Kutz. Sp. Alg. (1849). p. 174.

Cosmarium crenatum, Ralfs. Desm. (1848), t. 15, f. 7.

Archer in Prit. Inf. (1861), p. 732. Nordst. Desm. Grönl. (1885), p. 8. Delponte Desm. (1878), p. 6 (in part), t. 7, f. 25-27. Nordstedt Desm. Arct. (1875), p. 21, 38. Lundell Desm. Suec. (1871), p. 34. Nordstedt Desm. Spitz., p. 29. Nordstedt Norges Desm. (1873), p. 75. Petit Liste Desm. Paris (1877), p. 30. Grunow Desm. Austr. (1858), p. 497. Nordst. & Wittr. Desm. Ital. (1876), p. 35. Wood F. Water Algæ U.S. (1872), p. 131. Wolle Desm. U.S. (1884), p. 67, t. 49, f. 31, 32. Wille Norges Desm. (1880), p. 28. Schaarschm. Bosn. Serv. p. 7. Schaarschm. Magy. Desm. (1882), p. 265. Wittrock Scan. Desm. (1869), p. 10. Brebisson Liste Desm. (1856), p. 127. Notaris Desm. Ital. (1867), p. 47, t.

4, f. 34. Rabh. Alg. Eur. (1868), p. 165. Wille Nov. Sem. (1879), p. 40. Nordstedt Desm. Spitz. (1872), p. 29. Jacobsen Desm. Denm. (1874), p. 197 (partly). Kirchner Alg. Schles. (1878), p. 149.

Hab. In pools and ponds.

Lake District, Cornwall, Hants, Sussex, Wilts, Somerset, Lancashire, N. Wales, Scotland; France, Germany, Sweden, Norway, Spitzbergen, Nova Zembla, Greenland, Austria, Hungary, Italy, United States.

Plate XXXVII., fig. 13. *a*, living frond; *b*, empty frond; *c*, zygospore.

Cosmarium bicrenatum. *(Nords. Desm. Spitzb.).*

Frond minute, differing from *C. crenatum* in the lateral crenations being binate, and the upper angles without crenations.

Size Length 25 μ diam.; 17-18 μ (N.); length 28 μ; diam. 20 μ (N. & W.).

Joshua Journ. Bot. (1883), xxi., p. 291.

Cosmarium crenatum β bicrenatum, Nordst. Desm. Spitzb. (1872), p. 30, t. 6, f. 10. Nordst. Norges Desm. (1873), p. 15. Nordst. & Wittr. Desm. Ital. (1876), p. 35.

Hab. Mountain pools.

Den of Gight; Norway, Spitzbergen, Italy.

Plate XLII., fig. 13. *a*, living frond; *b*, empty frond; *c*, end view.

Cosmarium Reinschii. *Archer Micr. Journ.*, 1876, *t.* 16, *p.* 109.

Frond truncate, elliptical, nearly one-fourth longer than broad, constriction linear; segments ovate or semi-elliptic; ends straight, smooth; sides with three projecting nodules; end view elliptic, swollen in the middle.

Size. Length 33 μ; diam. 28 μ (Re.); diam. 30-35 μ (W.).

Wolle Desm. U.S. (1884), p. 68, t. 16, f. 12.

Cosmarium, sp., Reinsch Contrib. (1875), t. 18, f. 4.

Hab. In pools.

Penzance, Ireland; Germany, United States.

Plate XXXVII., fig. 14. *a*, living frond; *b*, empty frond; *c*, end view.

Cosmarium holmiense. *Lund. Desm. Suec.* (1871), *p.* 49, *t.* 2, *f.* 20.

Medium size; twice as long as broad, elliptically rectangular, constricted, with a narrow linear sinus; semi-cells sub-quadrate, gradually attenuated from the base, but slightly dilated at the apex; sides straight or sub-convex, obsoletely crenulate towards the apex; apex truncate, obsoletely biundulate, lower angles rounded, upper angles truncately rounded, end view broadly elliptic, obtuse angled at the poles ; side view rectangularly elliptic ; apex somewhat truncate, membrane smooth ; amylaceous granule single.

SIZE. Length 63-66 μ; diam. 38-40 μ (L.) ; diam. 33 μ; length 63 μ (W.) ; length 58-65 μ; diam. 33-40 μ (N.).

Wittr. Sottv. Alg. (1872), p. 60. Nordstedt Norges Desm. (1873), p. 24. Nordstedt Desm. Arct. (1875), p. 18, 38. Nordst. & Wittr. Desm. Ital. (1876), p. 31. Wille Nov. Sem. (1879), p. 36. Nordst. Desm. Grönl. (1885), p. 7. Nordst. Desm. Spitz. (1872), p. 28. Wolle Desm. U.S. (1884), p. 68, t. 16, f. 23.

HAB. Mountain pools, &c.

Lake District, N. Wales, Scotland; Norway, Spitzbergen, Nova Zembla, Greenland, Italy, United States.

var. *β*. Archer Micr. Journ. xv. (1875), p. 409.

var. **minor.** Archer Micr. Journ. xvi. (1876), p. 344.

Plate XXXVII., fig. 15. *a*, living frond; *b*, empty frond; *c*, side view; *d*, end view.

Cosmarium undulatum. *Corda Alm. Carls.* (1839), *t.* 5, *f.* 26.

Frond small, slightly longer than broad; constriction linear; segments semi-orbicular, ends and sides broadly rounded, crenate or minutely undulate at margin, end view elliptic. Zygospore orbicular, spinous; spines elongate, slender, swollen at the base, and divided at the apex.

SIZE. Length 60 μ; diam. 44 μ (K.) ; diam. 40-44 μ (W.) ; length 54 μ; diam. 39 μ (Wille).

Ralfs. Desm. (1848), p. 97, t. 15, f. 8. Wittr. Sottv. Alg. p. 59. Archer in Prit. Inf. (1861), p. 732, t. 2, f. 33, 34. Lundell Desm. Suec. (1871), p. 35. Nordstedt Norges Desm. (1873), p. 15. Nordstedt Desm. Arct. (1875), p. 41. Wood F. Water Algæ U.S. (1872), p. 132. Wittrock Scan. Desm. (1869), p. 11. Brebisson Liste Desm. (1856), 127. Rabh. Alg. Eur. (1868), p. 165. Nordstedt Desm. Spitz. (1872), 32. Wolle Desm. U.S. (1884), p. 67, t. 16, f. 20. Wille Norges Desm. (1880), p. 27. Schaarschm. Magy. Desm. (1882), p. 265. Jacobsen Desm. Denm. (1874), p. 197. Kirchner Alg. Schles. (1878), p. 149. Maskell N. Zeal. Desm. (1882), p. 242.

HAB. Mountain pools.

Lake District, Cornwall, Bristol, Sussex, N. Wales ; France, Germany, Austria, Denmark, Norway, Sweden, Russian Lapland, Hungary, Bohemia, Spitzbergen, United States, New Zealand.

Plate XXXVII., fig. 16. *a*, living frond ; *b*, empty frond ; *c*, semicell further magnified ; *d*, end view ; *e*, zygospore.

Cosmarium cambricum. *Cooke & Wills in Grevillea* IX. (1880), *p.* 91.

Frond longer than broad, constriction linear, segments quadrilateral, narrowed from the base, sides with two sinuations, and one in the centre of the apex, the latter rather the broadest. Side view oval, narrow, rounded at the ends, with a shallow constriction. End view elliptical. Cell membrane minutely punctate.

SIZE. Length 46-48 μ diam.; 36-38 μ at the base; 20-22 μ at the apex.

HAB. Mountain pools.

North Wales.

Plate XLII., fig. 16. *a,* living frond; *b,* empty frond; *c,* side view; *d,* end view.

Cosmarium tetragonum. *Näg. Einz. Alg., p.* 119, *t.* 7, *fig.* A, 5.

Frond in front view about twice as long as broad, oblong, constriction linear; segments subquadrate, somewhat narrowing from the base, sides and end each with three slight sinuations, those of the ends rather smaller, in each half one large central granule; side view segments oval, rounded, constriction shallow.

SIZE. Length 45-48 μ; diam. 22-26 μ.

Archer in Prit. Inf. (1861), p. 732. Nordstedt Norges Desm. (1873), p. 19. Nordstedt Desm. Arct. (1875), p. 40. Nordst. & Wittr. Desm. Ital. (1876), p. 35. Rabh. Alg. Eur. (1868), p. 164. Schaarschm. Magy. Desm. (1882), p. 269.

Euastrum tetragonum, Näg. Einz. Alg. (1849), p. 119, t. 7, f. A, 5.

HAB. In pools.

Lake District; France, Germany, Russian Lapland, Norway, Hungary, Italy.

Plate XXXVII., fig. 17. *a,* living frond; *b,* empty frond; *c,* side view; *d,* end view.

var. **Lundellii.** *Cooke.*

Form with the apices somewhat protracted; sides of the semi-cells very slightly bisinuate, upper angles straight, intermediate obtuse-angled.

SIZE. Length 42-46 μ; diam. 27 μ (L.).

Cosmarium tetragonum, Näg. *forma,* Lundell, t. 2, f. 21.

Quart. Journ. Mic. Sci. xvii. (1877), p. 102. Nordst. Desm. Grönl. (1885), p. 8.

HAB. In pools.

Scotland, Ireland; Germany, Greenland.

Plate XXXVII., fig. 18, *a,* living frond; *b,* empty frond; *c,* side view; *d,* end view.

Cosmarium monomaxum. *Lund. Desm. Suec., p. 32, t. 3, f. 11.*

About medium size, about as long as broad, or a little longer, deeply constricted, with a very narrow linear sinus; semi-cells hexagonally elliptic, apex truncate in the middle, convex, dorsal, and lateral margins delicately crenulate, with about 16 crenations; basal margin entire and obliquely truncate, with a single papilla in the middle; end view narrowly elliptic, with a single papillæ in the middle on each side, and a row of bifid papilla in a longitudinal series within the margin on each side; ends sub-truncate, with a small papilla at each angle; side view circular, with two papillæ on each side, one medial, the other near the apex.

SIZE. Length 38 μ; diam. 34 μ (L.).

HAB. Mountain pools.

Sweden.

var. β. **polymazon.** *Nordst. Norges Desm.* (1873), *p.* 14, *f.* 3.

HAB. Mountain pools.

Lake District; Norway.

Plate XXXVII., fig. 19. *a,* living frond; *b,* empty frond; *c,* side view; *d,* end view.

⁂ *Fronds rough on the surface with pearly granules, which give a denticulate appearance to the margin.*

Cosmarium tetraophthalmum. *Breb. in Ralfs. Desm.* (1848), *p.* 98, *t.* 17, *f* 11; *t.* 33, *f.* 8.

Frond about a third longer than broad, constriction deep, linear; segments forming nearly two-thirds of a circle, rough on the surface with short and broad scattered pearly granules giving a crenate appearance to the margin; end view broadly elliptic. Zygospore orbicular, spinous, spines swollen at the base, finely branched.

SIZE. Length 61-115 μ; diam. 50-79 μ (D.); diam. 60-78 (Wo.); length 120 μ; diam. 80 μ; length 110 μ; diam. 70 μ (C.).

Brebisson Liste Desm. (1856), p. 127. Maskell N. Zeal. Desm. (1882), p. 242. Archer in Prit. Inf. (1861), p. 732. Delponte Desm. (1878), t. 9, f. 1-4. Nordstedt Desm. Arct. (1875), p. 17 (var.) 40. Cleve Sver. Desm. (1864), p. 488. Lundell Desm. Suec. (1871), p. 27. Nordstedt Norges Desm. (1873), p. 12. Petit Liste Desm. Paris (1877), p. 30. Wittr. Sottv. Alg. (1872), p. 56. Lemaire Desm. Vosg. (1883), p. 19. Wolle Desm. U.S. (1884), 75, t. 13, f. 13. Grunow Desm. Austr. (1858), p. 501; Wood F. Water Algæ U.S. (1872), p. 129. Wittrock Scan. Desm. (1869), p. 12. Notaris Desm.

Ital. (1867), p. 38, t. 3, f. 19. Rabh. Alg. Eur. (1868), p. 159. Klebs. Desm. Pruss. (1879), p. 41. Nordst. Desm. Grönl. (1885), p. 7. Schaarschm. Magy. Desm. (1883), 264.

Heterocarpella tetraophthalmum, Kutz. Syn. (1833), f. 87.

Euastrum tetraophthalmum, Kutz. Phy. Germ. (1845), p. 136.

HAB. In pools.

Sussex, Hants, Surrey, Gloucester, Westmoreland, Cornwall, Wales, Scotland; France, Germany, Sweden, Norway, Russian Lapland, Italy, Spitzbergen, New Zealand.

Plate XXXVIII., fig. 1. *a*, living; frond; *b*, empty frond; *c*, side view; *d*, end view.

Cosmarium Brebissonii. *Meneg. Syn. Desm.* (1840), *p.* 219.

Frond somewhat longer than broad, constriction deep, linear; segments semi-orbicular, rough all over with somewhat elongated conical scattered pearly granules; end view elliptic.

SIZE. Length 50 μ; diam. 43 μ (D.); diam. 45-65 μ (Wo.); length 110 μ; diam. 80 μ (C.).

Ralfs. Desm. (1848), p. 100, t. 16, f. 3. Archer in Prit. Inf. (1861), p. 732. Delponte Desm. (1878) t. 9, f. 17-22. Cleve Sver. Desm. (1864), p. 488. Lundell Desm. Suec. (1871), p. 27. Nordstedt Norges Desm. (1873), p. 12. Nordstedt Desm. Arct. (1875), p. 40. Wood F. Water Algæ U.S. (1872), p. 128. Lemaire Desm. Vosg. (1883), p. 19. Wolle Desm. U.S. (1884), p. 75, t. 13, f. 10-11. Brebisson Liste Desm. (1856), p. 130. Rabh. Alg. Eur. (1868), p. 158. Jacobsen Desm. Denm. (1874), p. 194? in part.

Cosmarium margaritiferum, Kutz. Sp. Alg. (1849), p. 176, in part.

HAB. In pools.

Lake District; Kent, Sussex, Surrey, Hants, Wales, Warwickshire, Cornwall, France, Germany, Denmark, Sweden, Norway, Russian Lapland, Italy, United States.

Plate XXXVIII., fig. 2. *a*, living frond; *b*, empty frond; *c*, side view.

Cosmarium ovale. *Ralfs. Ann. Nat. Hist.* (1844), XIV., *t.* 11, *f.* 7.

Frond very large, elliptic, nearly twice as long as broad, constriction very deep, linear; segments somewhat broader than long, somewhat triangular, rounded at ends, rough near the margin with a band of large pearly granules, producing a dentate appearance, the disc punctate; end view elliptic.

SIZE. Length 180 μ; diam. 108 μ (D.); diam. 100 μ (Wo.); length 160 μ; diam. 100 μ (C.).

Hassall Fr. W. Alg. (1845), p. 366. Ralfs. Desm. (1848), p. 98, t. 15, f. 9. Archer in Prit. Inf. (1861), p. 733. Delponte Desm. (1878), t. 10, f. 1-4. Lundell Desm. Suec. (1871), 53. Nordstedt Norges Desm. (1873) p. 25. Wood F. Water Algæ U.S. (1872), p. 128. Brebisson Liste Desm. (1856), p. 128. Rabh. Alg. Eur. (1868), p. 158. Kirchner Alg. Schles. (1878), p. 148. Wolle Desm. U.S. (1884), p. 57, t. 13, f. 8-9.

HAB. In bogs.

Hants, Westmoreland; France, Germany, Norway, Sweden, Italy, United States.

Plate XXXVIII., fig. 8. *a*, living frond; *b*, empty frond; *c*, side view.

Cosmarium conspersum. *Ralfs. Desm.* (1848), *p.* 101, *t.* 16, *f.* 4.

Frond about a third longer than broad, constriction deep linear; segments quadrilateral, angles rounded, rough all over with depressed granules arranged in lines; end view elliptic.

SIZE. Diam. 50-73 μ (Wo.); length 90 μ; diam. 75 μ (C.)

Brebisson Liste Desm. (1856), p. 130. Archer in Prit. Inf. (1861), p. 732. Nordst. Desm. Braz. (1869), p. 208. Cleve Sver. Desm. (1864), p. 488. Nordst. Desm. Spitz. (1872), p. 27. Lundell Desm. Suec. (1871), p. 26. Nordstedt Norges Desm. (1873), p. 12. Grunow Desm. Austr. (1858), p. 501. Wittrock Scan. Desm. (1869), 13. Notaris Desm. Ital. (1867), p. 42, t. 3, f. 27. Rabh. Alg. Eur. (1868), p. 159. Wille Nov. Sem. (1879), p. 35. Wittr. Sottv. Alg. (1872), p. 56. Wolle Desm. U.S. (1884), p. 75, t. 14, f. 1, 2.

HAB. In pools.

Sussex, Wales, Lake District; France, Germany, Sweden, Norway, Austria, Italy, Nova Zembla, Brazil, United States.

Plate XXXIX., fig. 1. *a*, living frond; *b*, empty frond; *c*, end view.

Cosmarium latum. *Breb. Liste Desm., p.* 128, *t.* 1, *f.* 10.

Frond large, about as broad as long, constriction deep, sublinear; segments reniform, rough with rounded pearly granules arranged in somewhat curved transverse lines.

SIZE. Length 95 μ; diam. 80 μ (C.); length 80 μ; diam. 68 μ (L.); diam. 60 μ (Wo.).

Archer in Pritch. Infus. (1861), p. 733. Lundell Desm. Suec. (1871), p. 26. Nordst. Norges Desm. (1873), p. 11. Petit Desm. Paris (1877), p. 30. Lemaire Desm. Vosg. (1883), p. 19. Wolle Desm. U.S. (1884), p. 76, t. 13, f. 14.

HAB. In pools.

Lake District; France, Sweden, Norway, United States.

Plate XLI., fig. 8. *a*, living frond; *b*, empty frond.

Cosmarium quadrum. *Lundell Desm. Suec.* (1871), *p.* 25, *t.* 11, *f.* 11.

Rather large, about as long as broad, deeply constricted, with a narrow linear sinus, rather quadrate, apex very slightly retuse, sides almost straight, angles very broadly rounded, in side view each pole is rounded, and the middle broadly excavated, semi-cells with a straight contiguous base, lower angles rectangular, lateral margin crenate, dorsal margin densely crenulate, end view oblong. Membrane densely warted, warts in quincuncial order (about 17 longitudinal rows).

SIZE. Length 73-78 μ; diam. 70-72 μ (L.); length 78 μ; diam. 62 μ (C.).

Nordst. Norges Desm. (1873), p. 11. Lemaire Desm. Vosg. (1883), p. 19.

HAB. In ponds.

N. Wales; France, Sweden, Norway.

Plate XLII., fig. 1. *a*, living frond; *b c*, empty fronds.

Cosmarium quarternarium. *Witt. & Nord. in Alg. Exsicc., fasc.* 7.

Rather large. A little longer than broad, deeply constricted in the middle, with a linear sinus, dilated at the extremity; semi-cells somewhat trapezoid, sub-reniform at the base. Apex broadly truncate, without granules, inferior angles obtusely rounded, superior rounded, sides a little convex, granulately crenate, membrane rough with rather small radiating granules, with a central circular area, scrobiculate with connected granules; end view elliptic; side view circular. Chlorophyll with four parietal laminæ.

SIZE. Length 58-65 μ; diam 38-40 μ (N. & W.).

Grevillea ix. (1881), p. 102.

HAB. In ponds.

N. Wales; Italy.

Plate XLII., fig. 5. *a*, living frond; *b*, empty frond; *c*, end view.

Cosmarium margaritiferum. *(Turp.) Meneg. Syn. Desm.* (1840), *p.* 219.

Frond about as long as broad, constriction deep, linear; segments reniform or semi-orbicular, rough all over with round and scattered pearly granules; end view elliptic. Zygospore orbicular, spinous, with branched spines.

SIZE. Length 25-60 μ; diam. 26-50 μ (D.); diam. 25-50 μ (Wo.), 25 × 26 μ to 60 × 50 μ (C.).

Ralfs. Ann. Nat. Hist. (1844), xiv., t. 11, f. 4. Ralfs. Desm. (1848), p. 100, t. 16, f. 2; t. 33, f. 3. Archer in Prit. Inf. (1861), p. 733, t. 1, f. 1. Delponte Desm. (1878), t. 9, f. 5-9. Cleve Sver. Desm. (1864), p. 488. Wolle Desm. U.S. (1884), p. 74, t. 13, f. 1-3. Lundell Desm. Suec. (1871), p. 25. Nordstedt Norges Desm. (1873), p. 11. Petit Liste Desm. Paris (1877), p. 30. Grunow Desm. Austr. (1858), p. 501. Wood F. Water Algæ U.S. (1872), p. 127. Wittrock Scan. Desm. (1869), p. 12. Brebisson Liste Desm. (1856), p. 129. Notaris Desm. Ital. (1867), p. 44, t. 4, f. 29. Rabh. Alg. Eur. (1868), p. 157 in part. Jacobsen Desm. Denm. (1874), p. 193 partly. Kirchner Alg. Schles. (1878), p. 150. Nordst. Desm. Braz. (1869), p. 207. Wittr. Sottv. Alg. (1872), p. 56. Schaarschm. Magy. Desm. (1883), p. 264. Lemaire Desm. Vosg. (1883), p. 19.

Ursinella margaritifera, Turp. Dict. Sc. Nat. (1820), f. 23. Mem. de Mus., p. 295, t. 13, f. 19.

Euastrum margaritiferum, Ehr. Abh. der Berl. Ak. (1833), p. 246. Ehr. Inf., p. 163, t. 12, f. 7.

Micrasterias margaritifera, Breb. Alg. Fal. (1835), p. 55, t. 7.

Cymbella reniformis, Ag. Consp. Diat. (1830), p. 10. Harv. Br. Alg., p. 215.

HAB. In ponds, ditches, &c.

Common throughout England, Wales, Scotland; France, Germany, Sweden, Norway, Denmark, Austria, Italy, Hungary, Brazil, Mexico, United States.

Plate XXXIX., fig. 2. a, living frond; *b*, empty frond; *c*, side view; *d*, end view; *e*, zygospore.

Cosmarium Portianum. *Archer in Pritch. Infus.* (1861), *p.* 733.

Frond about one-third longer than broad, constriction deep, vide; somewhat round below, isthmus forming a short neck; segments elliptical, rough all over with minute scattered pearly granules; end view elliptic. (Zygospore orbicular, beset with somewhat elongate conical blunt spines.)

SIZE. Length 40 μ diam., 25 μ (A.); diam. 25-33 μ (Wo.); ength 40 μ; diam. 30 μ (C.).

Micr. Journ. viii. (1860), p. 235, t. 11, f. 8, 9. Nordstedt Desm. Arct. (1875), p. 18. Lundell Desm. Suec. (1871), p. 26. Nordstedt Norges Desm. (1873), p. 22. Nordst. & Wittr. Desm. Ital. (1876), p. 28. Rabh. Alg. Eur. (1868), p. 160. Ville Nov. Zem. (1879), p. 34. Wille Norges Fers. (1880), . 24. Wittr. Sottv. Alg. (1872), p. 57. Lemaire Desm. Vosg. (1883), p. 21. Wolle Desm. U.S. (1884), p. 77, t. 14, 12-14.

HAB. In pools.

Ireland, Cornwall, Lake District; France, Sweden, Norway, Italy, Spitzbergen, Nova Zembla, United States.

Plate XXXIX., fig. 3. *a d*, living fronds; *b c*, empty frond; *e*, end view; *f*, zygospore.

Cosmarium reniforme. *Archer in Journ. Bot.* (1874), III., *p.* 93.

Segments reniform, in end view equally elliptic. Zygospore globose, armed with long spines, which are cleft at the summit.

SIZE. Length 50 μ; diam. 50 μ.

Nordstedt Desm. Arct. (1875), p. 40. Wolle Desm. U.S. (1884), p. 76, t. 14, f. 10, 11.

Cosmarium margaritiferum of authors (in part).

Cosmarium margaritiferum, forma *genuina*, Nordstedt Norges Desm. (1873), p. 11.

Cosmarium margaritiferum, var. *reniforme*, Ralfs. Desm. p. 100.

HAB. In ponds.

Cornwall, Lake District; Norway, Russian Lapland, United States.

Plate XLII., fig. 10. *a*, living frond; *b*, empty frond.

Cosmarium Logiense. *Bisset. Roy. Micr. Journ.* (1884), *p.* 194, *t.* 5, *f.* 4.

Frond of medium size, outline sub-elliptic, one and a half times as long as broad, deeply constricted, with a narrow linear sinus, semi-cells more than semi-circular, nearly two-thirds of a circle; sometimes with a wide and very shallow depression at the ends. Cell membrane rough all over with small pearly granules.

SIZE. Length 70-73 μ; diam. 47-50 μ (B.).

HAB. In mountain pools.

Ambleside, &c. (Britain), Scotland.

Plate XLI., fig. 5. *a*, living frond; *b*, empty frond.

Cosmarium punctulatum. *Breb. Liste Desm.* (1856), *p.* 129, *t.* 1, *f.* 16.

Frond, about as long as broad, constriction linear, segments subreniform, clad with small scattered granules, or sometimes punctate; end view elliptic.

Zygospore orbicular, elegantly beset with rather short and thick processes, which are rounded above and margined by a number of very short, acute spinelets, with a central slender, elongate, slightly tapering process, bifid or trifid at the extremity.

SIZE. Length 22-30 μ; diam. 22 μ (N.); length 24-31 μ; diam. 20-26 μ (Wille); diam. 20-30 μ (Wo.).

Nordstedt Desm. Spitz. (1872), p. 26, t. 6, f. 1 (?). Notaris Desm. Ital. (1867), t. 4, f. 33, left lower fig. Klebs. Desm. Pruss. (1879), p. 37. Kirchner Alg. Schles. (1878), p. 148. Nordst. Norges Desm. (1873), p. 12. Maskell N. Zeal. Desm. (1882), p. 239. Nordst. Desm. Grönl. (1885), p. 7. Nordst. Desm. Arct. (1875), p. 17, p. 40. Wille Norges Fers. (1880), p. 24. Wille Nova Zem. (1879), p. 33. Wittr. Sottv. Alg. (1872), p. 57. Schaarschm. Magy. Desm. (1883), p. 264. Petit Desm. Paris (1877), p. 30. Lemaire Desm. Vosg. (1883), p. 19. Wolle Desm. U.S. (1884), p. 74, t. 13, f. 4.

HAB. In pools.

Cornwall, Lake District; France, Germany, Norway, Italy, Greenland, Hungary, Nova Zembla, Spitzbergen, Russian Lapland, New Zealand, United States.

Plate XLII., fig. 7. *a*, living frond; *b*, empty frond; *c*, side view; *d*, end view.

Cosmarium orthostichum. *Lundell Desm. Suec.* (1871), *p.* 24, *t.* 2, *f.* 9.

Medium size, a little longer than broad, deeply constricted, with a narrow linear sinus, semi-cells subelliptic, broadly rounded at the ends; ventral margin straight, granulate, granules in 7-8 series, vertically disposed, end view elliptic, granulate, smooth in the centre, side view circular.

SIZE. Length 34-36 μ; diam. 30-33 μ (L.); diam. 20-30 μ (Wo.).

Nordst. Norges Desm. (1873), p. 11. Wille Norges Fers. (1880), p. 24. Wolle Desm. U.S. (1884), p. 78, t. 18, f. 4, 5.

HAB. In pools.

Sweden, Norway, United States.

Plate XLII., fig. 3. *a*, living frond; *b*, empty frond; *c*, end view; *d*, side view.

Cosmarium botrytis. *Meneg. Syn. Desm.* (1840), *p.* 220.

Frond rather longer than broad, constriction deep, linear; segments twice as broad as long, broadest at base, narrowing upwards, sides rather rounded, ends truncate, rough all over with scattered rounded pearly granules; end view broadly elliptic. Zygospore orbicular, spinous, spines elongated and slightly divided at the apex.

SIZE. Length 72 μ; diam. 57 μ (D.); diam. 35-62 μ (Wo.); length 85 μ; diam. 65 μ; length 68 μ; diam. 52 μ (C).

Ralfs. Ann. Nat. Hist. (1844), xiv., p. 393, t. 11, f. 5. Ralfs. Desm. (1848), p. 99, t. 16, f. 1. Archer in Prit. Inf. (1861),

p. 733. Hassall Fr. W. Alg., p. 363. Delponte Desm. (1878), t. 8, f. 31-39. Nordstedt Desm. Arct. (1875), p. 17. Cleve Sver. Desm. (1864), p. 488. Lundell Desm. Suec. (1871), p. 26. Maskell N. Zeal. Desm. (1882), p. 242. Wolle Desm. U.S. (1884), p. 74, t. 13, f. 5-7. Nordstedt. Norges Desm. (1873), p. 12. Grunow Desm. Austr. (1858), p. 501. Nordst. & Wittr. Desm. Ital. (1876), p. 27. Wood F. Water Algæ U.S. (1872), p. 128. Wittrock Scan. Desm. (1869), p. 12. Brebisson Liste Desm. (1856), p. 128. Notaris Desm. Ital. (1867), p. 43, t. 3, f. 28. Rabh. Alg. Eur. (1868), p. 158. Wille Nov. Zem. (1879), p. 34. Nordstedt Desm. Spitz. (1872), p. 27. Klebs. Desm. Pruss. (1879), p. 39, in part. Jacobsen Desm. Denm. (1874), p. 193. Kirchner Alg. Schles. (1878), p. 151. Nordst. Desm. Braz. (1869), p. 207. Wittr. Sottv. Alg. (1872), p. 56. Schaarschm. Magy. Desm. (1883), p. 263. Lemaire Desm. Vosg. (1883), p. 19.

Heterocarpella botrytis, Bory Dict. Class. (1823), t. 8.

Cosmarium deltoides, Corda. Alm. Carls. (1835), p. 120, f. 18.

Euastrum botrytis, Ehr. Infus. (1838), p. 163.

Euastrum angulosum, Ehr. Infus. (1838), t. 10, f. 8.

HAB. In pools.

Sussex, Essex, Gloucester, Cornwall, Lancashire, Westmoreland, Wales, Scotland; Germany, France, Italy, Denmark, Austria, Hungary, Norway, Spitzbergen, Sweden, Nova Zembla, New Zealand, United States, Brazil.

Plate XXXIX., fig. 4. *a c*, living fronds; *b d*, empty fronds; *e*, end view; *f*, side view; *g*, zygospore.

Cosmarium Turpini. *Breb. Liste Desm.* (1856), *p.* 127.

Frond about as long as broad, constriction deep linear, segments twice as broad as long, somewhat triangular, much inflated and broadly rounded at the base, rapidly attenuated, sides concave, ends truncate, rough all over with scattered pearly granules, and with a central granulated protuberance, end view narrowly elliptic, with the central broad truncate protuberance on each side.

SIZE. Length 72 μ; diam. 66 μ (L.); diam. 55-70 μ (Wo.); length 72 μ; diam. 72 μ (D.).

Wittr. Sottv. Alg. (1872), p. 56. Schaarschm. Magy. Desm. (1883), p. 264. Wolle Desm. U.S. (1884), p. 158, t. 17, f. 24, 25. Archer in Pritch. Infus. (1861), p. 733. Lundell Desm. Suec. (1871), p. 29. Nordst. Norges Desm. (1873), p. 13. Wille Nova Zem. (1879), p. 35.

Heterocarpella didelta, Turpin. Mem. Mus. xvi, p. 295. fig. 16.

Cosmarium didelta, Kutz. Sp. Alg. (1849), p. 174.

Cosmarium protractum, Cleve Bidrag (1864), p. 488.

Wiltshire, North Wales; France, Germany, Norway, Sweden, Hungary, Italy, United States.

var. **cambricum.** *Josh. Journ. Bot.* (1885), *p.* 35, *t.* 254, *f.* 8.

Rather smaller than the typical form, more rotundate, less truncate; basal angles less protruded; form of central inflation two distinct ovals set obliquely, composed of oblong granules.

SIZE. Length 60 μ; thickness, with inflation, 35 μ; width 50-60 μ; isthmus 17 μ.

HAB. In pools.

North Wales.

Plate XLI., fig. 4. *a*, living frond; *b*, empty frond; *c*, end view; *d*, side view.

Cosmarium sportella. *Breb. in Pritch. Infus.* (1861), *p.* 734.

Frond about as long as broad, constriction deep, linear, segments reniform, with a central truncate projection at the ends, its angles slightly dilated and denticulate, rough all over with scattered pearly granules.

SIZE. Length 45 μ; diam. 43 μ (C.).

Nordst. & Wittr. Desm. Ital. (1876), p. 28.

HAB. In pools.

Lake District, Den of Gight; France, Italy.

Plate XLI., fig. 6. *a*, living frond; *b*, empty frond; *c*, side view; *d*, end view.

Cosmarium corbula. *Breb. in Pritch. Infus.* (1861), *p.* 734.

Frond about as long as broad, constriction deep, linear, segments subreniform, a central truncate projection at the ends, with its angles slightly dilated and minutely denticulate, furnished at the centre of each segment with a circular protuberance bordered with granules, and rough thereon, and towards the margin with scattered pearly granules.

SIZE. Length and diam. 35-38 μ (C.).

Wolle Desm. U.S. (1884), p. 83, t. 49, f. 28-30?

HAB. In ponds.

France, United States.

Plate XLIII., fig. 9. *a*, living frond; *b b*, empty fronds; *c*, end view,

Cosmarium præmorsum. *Breb. in Pritch. Inf.* (1861), *p.* 733.

Frond rather longer than broad, constriction deep, linear, segments broadly reniform, sides rounded, ends somewhat truncate, rough with pearly granules, an annular series of which, more elevated than the rest, forms a ridge at the end bounding a circular depression ; end view elliptic.

Size. Length 43-53 μ ; diam. 38 μ (N.).

Nordst. Norges Desm. (1873), p. 12. Wille Norges Fers. (1880), p. 25.

Hab. In ponds and bogs.

Lake District ; France, Norway.

Plate XLII., fig. 2. *a*, living frond ; *b*, empty frond ; *c*, end view ; *d*, side view.

Cosmarium coronatum. *Cke. & Wills, Grevillea* (1880) IX., *p.* 90.

Rather large. Frond about as long as broad, or rather shorter, constriction deep, linear, semi-cells quadrilateral, narrowest at the base, dilated upwards, very slightly convex at the ends, rough all over with elongated conical granules, arranged in lines (about eight at the end and four on each side), side view truncate at the ends, end view elliptic.

Size. Length 65-70 μ; diam. 75-80 μ; side view diam. 45 μ (C. & W.).

Hab. In mountain pools.

North Wales.

Plate XLI., fig. 7. *a*, living frond ; *b*, empty frond ; *c*, side view ; *d*, end view.

Cosmarium biretum. *Breb. in Ralfs. Desm.* (1848), *p.* 102, *t.* 16, *f.* 5.

Frond in front view about as long as broad ; constriction deep, linear ; segments quadrilateral or subhexagonal, narrowest at the base, and dilated upwards, convex or somewhat truncate at the ends ; rough all over with small granules arranged somewhat in lines ; end view with a rounded lobe on each side and rounded at the ends.

Size. Diam. 55-60 μ (Wo.) ; length 85 μ ; diam. 85 μ (C.).

Archer in Prit. Inf. (1861), p. 733. Nordstedt Desm. Arct. (1875), p. 26. Cleve Sver. Desm. (1864), p. 488. Lundell Desm. Suec. (1871), p. 30. Petit Liste Desm. Paris (1877), p. 30. Nordst. & Wittr. Desm. Ital. (1876), p. 40. Rabh. Alg. Eur. (1868), p. 171. Wittr. Sottv. Alg. (1872), p. 55. Schaarschm. Magy. Desm. (1883), p. 264. Wolle Desm. U.S. (1884), p. 86, t. 17, f. 1, 2.. Wille Nov. Zem. (1879), p. 35. Kirchner Alg. Schles. (1878), p. 154.

Hab. In ponds.

Sussex ; France, Germany, Sweden, Italy, Hungary, Nova Zembla, United States.

var. triquetrum. *Breb. Liste Desm.* (1856), *p.* 130. *Rabh. Alg. Eur.* (1868), *p.* 171.

End view with three rounded angles; sides deeply sinuous.

France, Spitzbergen, Sweden, Nova Zembla.

Plate XXXIX., fig. 5. *a c*, living fronds; *b d*, empty fronds; *e*, end view.

Cosmarium Broomei. *Thw. in Ralfs. Desm.* (1848), *p.* 103, *t.* 16, *f.* 6; *t.* 32, *f.* 7.

Frond in front view about as long as broad, constriction deep, linear; segments quadrilateral, ends straight, angles rounded, rough all over with minute granules; end view twice as long as broad, slightly inflated at the middle, and rounded at the ends. Zygospore orbicular, smooth.

SIZE. Length 57 μ; diam. 57 μ (D.); diam. 30-45 μ (Wo.); length 50 μ; diam. 42 μ (C.).

Brebisson Liste Desm. (1856), p. 130. Archer in Prit. Inf. (1861), p. 734, t. 1, f. 7. Delponte Desm. (1878), t. 8, f. 44-48? Lundell Desm. Suec. (1871), p. 29. Nordst & Wittr. Desm. Ital. (1876), p. 41. Wood F. Water Algæ U.S. (1872), p. 133. Wolle Desm. U.S. (1884), p. 86, t. 17, f. 6-9. Wittrock Scan. Desm. (1869), p. 13. Rabh. Alg. Eur. (1868), p. 171. Jacobsen Desm. Denm. (1874), p. 194. Kirchner Alg. Schles. (1878), p. 154.

HAB. In brackish water.

Sussex, Gloucester, Cornwall; France, Germany, Sweden, Denmark, Italy, United States.

Plate XL., fig. 1. *a c*, living fronds; *b d*, empty fronds; *e*, end view.

Cosmarium ochthodes. *Nordst. Desm. Arct.* (1875), *p.* 17, *t.* VI., *f.* 3.

Medium size, about one-half longer than broad, elliptical-oblong, deeply constricted, with a narrow linear sinus, semi-cells semi-circular or sometimes almost triangular, with convex sides, apex rounded, lower angles rectangular, margin densely crenate, end view elliptic, side view obovate, membrane densely warted with depressed warts, arranged in radiating concentric series, at the apex of the semi-cells, and in the centre often less distinct.

SIZE. Length 70-90 μ; diam. 51-66 μ; isthmus 18-27 μ (N.), 87-98 μ × 64-72 μ (N. & W.); diam. 52-70 μ (Wo.).

Nordst. Desm. Arct. (1875), p. 40. Nordst. & Wittr. Desm. Ital. (1876), p. 28. Wille Nova Zem. (1879), p. 35. Lemaire Desm. Vosg. (1883), p. 19. Wolle Desm. U.S. (1884), p. 76, t. 14, f. 10, 11.

Euastrum margaritiferum, Focke Phys. Stud. i, p. 42, in part.

Hab. In pools.

Lake District; France, Germany, Italy, Spitzbergen, Russian Lapland, Nova Zembla, United States.

Plate XLI., fig. 3. *a,* living frond; *b,* empty frond; *c,* end view; *d,* side view.

Cosmarium confusum. *Cooke MSS.*

Medium size or small, constriction deep, linear, lower angles very acute, rectangular; lateral margins for a time vertical, then arching round to form very broadly rounded upper angles, which merge into the subtruncate upper margin; lateral margins irregularly serratulo-undulate, the crenatures so formed becoming somewhat smaller upwards, presently becoming obsolete; on upper angle and upper margin nearly smooth; front surface granulate, granules faint and scattered; end view fusiform-elliptic.

Size. Length and diam. 48-50 μ.

Cosmarium Brebissonii, Jacobsen Copenhagen Journ. Bot., t. vii., f. 15 (forma genuina latior et angustior). Archer Micr. Journ. 1877, xviii., p. 305.

Hab. In bogs.

Ireland; Denmark.

Plate XLII., fig. 9. *a,* living frond; *b,* empty frond.

Cosmarium amœnum. *Breb. in Ralfs. Desm.* (1848), *p.* 102, *t.* 17, *f.* 3.

Frond twice as long as broad, sides parallel, ends rounded, constriction deep, linear; segments rough with crowded obtuse papilla-like pearly granules; side view much compressed, about thrice as long as broad; end view elliptic.

Size. Diam. 20-25 μ (Wo.); length 50 μ; diam. 22 μ (C.).

Breb. Liste Desm. (1856), p. 130. Archer in Prit. Inf. (1861), p. 733. Lundell Desm. Suec. (1871), p. 46. Nordstedt Norges Desm. (1873), p. 22. Petit Liste Desm. Paris (1877), p. 30. Nordst. Desm. Braz. (1869), p. 209. Grunow Desm. Austr. (1858), p. 501. Wood F. Water Algæ U.S. (1872), p. 130. Rabh. Alg. Eur. (1868), p. 159. Rabh. Kryp. Fl. Sachs. (1863), p. 201. Lemaire Desm. Vosg. (1883), p. 21. Wolle Desm. U.S. (1884), p. 78, t. 14, f. 5-7. Wittrock Scan. Desm. (1869), p. 14. Notaris Desm. Ital. (1867), p. 44, t. 4, f. 30. Jacobsen Desm. Denm. (1874), p. 196. Kirchner Alg. Schles. (1878), p. 152. Wille Norges Fers. (1880), p. 37.

HAB. In pools.

Westmoreland, Cornwall, Wales; France, Germany, Sweden, Norway, Denmark, Italy, Brazil, United States.

Plate XL., fig. 2. *a*, living frond; *b c*, empty fronds; *d*, side view.

Cosmarium Boeckii. *Wille Norges Fers.* (1880), *p.* 28, *t.* 1, *f.* 10.

Medium size, a little longer than broad, deeply constricted, with a very narrow linear sinus. Semi-cells semi-circular, truncate at the apex, five-crenate, sides with three crenations, the median entire, the others with the apex slightly emarginate; semi-cells granulate about the margin, in two series, the exterior of 15, the interior of 9 granules, in the centre a tumour with four granules cruciately disposed; side view obovate-circular, granulate at the margin; end view elliptic, with a median tumour on each side with three granules; apices five-granulate.

SIZE. Length 29 μ; diam. 27 μ (W.).

HAB. Mountain pools.

Lake District, Cornwall; Norway.

Plate XLII., fig. 4. *a*, living frond; *b*, empty frond; view; *d*, side view.

Cosmarium sphalerostichum. *Nord. & Wittr. Desm. Ital.* (1876), *p.* 28, *t.* 12, *f.* 3.

Small, a little longer than broad, deeply constricted, with a narrow linear sinus; semi-cells subreniform, or trapezoid, straight at the base, lower angles rectangular, dorsal margin broadly truncate and naked, granulated, the granules in the middle of the semi-cells often arranged in two or three vertical series, the rest irregularly disposed; end view elliptic, margin delicately granulate, the granules, 1-3, in the middle larger and more distinct; side view circular, granulate. Zygospore globose, or subglobose, smooth.

SIZE. Length 15-20 μ; diam. 13-14 μ; zygospore diam. 18-20 μ (N. & W.).

HAB. In pools.

N. Wales; Italy.

Plate XLII., fig. 6. *a*, living frond; *b b*, empty fronds; *c*, side view; *d*, end view.

Cosmarium cœlatum. *Ralfs. Desm.* (1848), *p.* 103, *t.* 17, *f.* 1.

Frond in front view about as long as broad, sub-orbicular, constriction deep, linear; segments semi-orbicular, with six broad crenatures at margin, rough at margin with scattered pearly granules, and at the centre with granules somewhat concentrically arranged; end view twice as long as broad, with a broad inflation at each side.

SIZE. Diam. 40 μ (Wo.); length 53 μ; diam. 50 μ (C.).

Archer in Prit. Inf. (1861), p. 734, t. 2, f. 26. Lundell Desm. Suec. (1871), p. 33. Nordstedt Norges Desm. (1873), p. 14. Grunow Desm. Austr. (1858), p. 501. Nordst. & Wittr. Desm. Ital. (1876), p. 40. Wolle Desm. U.S. (1884), p. 86, t. 18, f. 46-48. Wood F. Water Algæ U.S. (1872), p. 133. Brebisson Liste Desm. (1856), p. 131. Rabh. Alg. Eur. (1868), p. 170. Kirchner Alg. Schles. (1878), p. 154. Lemaire Desm. Vosg. (1883), p. 19.

HAB. In pools.

Kent, Sussex, North Wales, Cornwall, Lake District; France, Germany, Norway, Sweden, Austria, Italy, United States.

Plate XL., fig. 3. *a*, living fronds; *b*, empty fronds; *f*, side view; *g*, end view.

Cosmarium ornatum. *Ralfs. Ann. Nat. Hist.* (1844), XIV., *p.* 392, *t.* 11, *f.* 3.

Frond in front view about as long as broad, constriction deep, linear; segments semi-orbicular or subreniform, with a central truncate projection at the ends, produced by the continuation of a central inflation, rough towards the margin and on the inflation, with pearly granules; end view with a rounded lobe on each side. Zygospore orbicular, spiny, spines elongated, dilated at the base, and slightly divided at the apex.

SIZE. Diam. 33-45 μ (Wo.); length 38-40 μ; diam. 38-40 μ (C.).

Ralfs. Desm. (1848), p. 104, t. 16, f. 7. Wolle Desm. U.S. (1884), p. 82, t. 18, f. 39-45; t. 49, f. 22-24. Archer in Prit. Inf. (1861), p. 734. Lundell Desm. Suec. (1871), p. 28. Nordstedt Norges Desm. (1873), p. 13. Petit Liste Desm. Paris (1877), p. 30. Wood F. Water Algæ U.S. (1872), p. 133. Brebisson Liste Desm. (1856), p. 130. Rabh. Alg. Eur. (1868), p. 169. Jacobsen Desm. Denm. (1874), p. 194. Kirchner Alg. Schles. (1878), p. 153. Nordst. Desm. Braz. (1869), p. 213. Wittr. Sottv. Alg. (1872), p. 55. Lemaire Desm. Vosg. (1883), p. 19.

HAB. In ponds.

Widely distributed. Sussex, Hants, Essex, Westmoreland, Cornwall, Wales, Scotland; France, Germany, Sweden, Norway, Denmark, Italy, Brazil, United States.

Plate XL., fig. 4. *a*, living frond; *b c*, empty fronds; *d*, end view.

Cosmarium Kjellmanni. *Wille Nova Zem.* (1879), *p.* 42, *t.* 12, *f.* 31.

Medium size, about as long as broad, sub-rectangular, deeply constricted in the middle, with a linear sinus; semi-cells very broadly heart-shaped, sides slightly convex, apex truncate, with four to six slight undulations, lateral margins furnished with six small teeth, granules of the semi-cells radiately and longitudinally disposed, none in the centre, but with an elevated granular basal tumor, granules disposed in five vertical series; end view elliptic, with a five-granulate tumor on each side at the middle. Side view ovate, with a granulate tumor on each side.

SIZE. Length 28 μ; diam. 28 μ (W.); diam. 20-25 μ (Wo.).

Wille Norges Fers. (1880), p. 29. Wolle Desm. U.S. (1884), p. 87, t. 49, f. 19-21.

HAB. In pools.

Lake District; Nova Zembla, United States.

Plate XLII., fig. 11. *a*, living frond; *b*, empty frond; *c*, end view; *d*, side view.

Cosmarium commissurale. *Breb. in Meneg. Syn. Desm.* (1840) *p.* 220.

Frond small, in front view one-third broader than long, constriction very deep, rounded; segments narrow, reniform, with a central somewhat truncate projection, produced by the continuation of the central inflation; rough on the inflation and on the extremities, with somewhat large pearly granules; end view three times longer than broad, constricted between the central inflation and the rounded extremities. Zygospore orbicular, spiny.

SIZE. Length 25-30 μ; diam. 34-38 μ (Wo.); length 30 μ; diam. 40 μ.

Ralfs. Desm. (1848), p. 105, t. 16, f. 8. Archer in Prit. Inf. (1861), p. 734. Brebisson Liste Desm. (1856), p. 131. Petit Liste Desm. Paris (1877), p. 30. Wood F. Water Algæ U.S. (1872), p. 132. Rabh. Alg. Eur. (1868), p. 170. Nordst. Desm. Braz. (1869), p. 213. Wolle Desm. U.S. (1884), p. 83, t. 18, f. 49-51.

HAB. In ponds.

Sussex, Gloucester, Cornwall; France, Germany, Brazil, United States.

var. *β* **acutum.** *Breb.*

Angles sharper.

Plate XL., fig. 5. *a*, living frond; *b*, empty frond; *c*, end view; *d*, zygospore.

Cosmarium cristatum. *Ralfs. Desm.* (1848), *p.* 105, *t.* 17, *f.* 2.

Frond in front view as long as broad, orbicular, constriction deep, linear; segments semi-orbicular, margined by a series of obtuse papilla-like pearly granules, and having at the centre of each a circular granulate inflation; end view linear, truncate at ends, with a slight central inflation at each side.

SIZE. 40-43 μ (C.).

Brebisson Liste Desm. (1866), p. 131. Archer in Prit. Inf. (1861), p. 734. Rabh. Alg. Eur. (1868), p. 172. Schaarschm. Magy. Desm. (1883), p. 264.

HAB. In pools.

Westmoreland; France, Germany, Hungary.

Plate XL., fig. 6. *a c*, living fronds; *b d*, empty fronds; *e*, end view.

Cosmarium quinarium. *Lundell Desm. Suec.* (1871), *p.* 28, *t.* 2, *f.* 14.

Medium size, sub-hexagonal, about a fourth part longer than broad, with a deep linear median incision, semi-cells subtrapezoid, narrowed upwards, dorsal margin somewhat truncate, sides slightly convex, lower angles obtuse, margin obsoletely granulate-dentate, the granules near the margin more acute, in the centre five obtuse granules, in two transverse series, end view elliptic, granulate, centre smooth; side view circular with three granules on each side.

SIZE. Length 39-42 μ; diam. 33-34$\frac{1}{2}$ μ; isthmus 9$\frac{1}{2}$ μ (L.).

Nordst. Norges Desm. (1871), p. 13. Archer in Journ. Bot. iii. (1874), p. 93.

HAB. In mountain pools.

Ireland; Sweden, Norway.

Plate XL., fig. 7. *a*, living frond; *b*, empty frond; *c*, end view.

Cosmarium isthmochondrium. *Nordst. Norges Desm.* (1871), *p.* 12, *fig.* 2.

Medium size, sub-hexagonal, a fourth part longer than broad, with a deep linear median incision, semi-cells semi-circular, dorsal margin truncate and naked, sides somewhat convex, margin obsoletely granulate-dentate, a series of granules within the lateral margins, and two larger within the dorsal margin, lower angles obtuse with a papilla, with one or a pair in the centre, and one at the isthmus; end view elliptic, margin obsoletely granulate, in the middle within the margin on each side two larger papillæ; side view circular, with a basal papilla.

SIZE. Length 33-35 μ; diam. 28-30 μ; isthmus 11 μ (N.).

HAB. In mountain pools.

Lake District; Norway.

Plate XLI., fig. 9. *a*, living frond; *b*, empty frond; *c*, end view; *d*, side view.

Cosmarium quadrifarium. *Lundell Desm. Suec.* (1871), *p.* 32, *t.* 3, *f.* 12.

Of medium size; one-quarter longer than broad, deeply constricted, with a narrow linear sinus, semi-cells semi-circular, margin furnished with seventeen emarginate-truncate verrucæ, and a similar series within the margin, basal tumor orbicular, ornamented with 12-17 granules, end view elliptic in outline with a granulate tumor on each side at the middle, four longitudinal series of bifid verrucæ down the centre, side view with a granular tumor on each side, the apex crowned with four papillæ. Zygospore sub-quadrate, smooth.

SIZE. Length 40-44 μ; diam. 32-36 μ (L.); zygospore 40 × 34 μ.

Nordst. Norges Desm. (1871), p. 14. Archer in Journ. Bot. (1874) iii., p. 93. Wolle Desm. U.S. (1884), p. 87, t. 17, f. 16-18.

HAB. In mountain pools.

Ireland, Arran; Sweden, Norway, United States.

Plate XL., fig. 8. *a*, living frond; *b*, empty frond; *c*, end view; *d*, zygospore.

Cosmarium hexastichum. *Lundell Desm. Suec.* (1871), *p.* 33, *t.* 3, *f.* 13.

Medium size, a fourth part longer than broad, deeply constricted, with a linear sinus, a little dilated outwards, semi-cells perfectly semi-circular, lower angles rectangular, margin ornamented with 15 emarginate truncate warts, and within the margin two similar concentric series, furnished with a semi-orbicular warted basal tumor, warts nine (2-4 fid), disposed in two transverse lines, end view elliptic, swollen and warted in the middle on each side, at each end six crenations, in the middle six series of bifid warts in longitudinal lines; side view apex broadly rounded with six crenations, on each side ventricose above the base, and furnished with two emarginate warts.

SIZE. Length 53 μ; diam. 42-44 μ; isthmus 21 μ (L.).

Nordst. Norg. Desm., p. 14. Archer in Journ. Bot. (1874) iii., p. 93. Nordst. Desm. Grönl. (1885), p. 9.

HAB. In pools.

Ireland; Sweden, Norway, Greenland.

Plate XL., fig. 9. *a*, living frond; *b*, empty frond; *c*, end view; *d*, side view.

Cosmarium hexalobum. *Nordst. Desm. Spitz.* (1872), *p.* 33, *t.* 7, *f.* 16.

Somewhat hexagonal, about one-quarter longer than broad, constriction linear, segments trapezoid, sides with about four crenatures, slightly constricted beneath the apex, granules on a basal nodular swelling in 4 to 6 vertical series, side view rectangular, end view broadly elliptic, ventricose, and crenate in the middle, everywhere granular.

SIZE. Length 45-50 μ; diam. 35-40 μ.

Archer in Quart. Journ. Micr. Sci. (1879), xix., p. 441. Wille Nov. Zem. (1879), p. 47. Nordst. Norges Desm. (1873), p. 15. Nordst. Desm. Grönl. (1885), p. 9. Nordst. Desm. Arct. (1875), p. 27, p. 41.

HAB. In pools.

Ireland; Norway, Greenland, Nova Zembla, Spitzbergen, Russian Lapland.

Plate XL., fig. 10. *a*, living frond; *b*, empty frond; *c*, side view; *d*, end view.

Cosmarium cyclicum. *Lundell Desm. Suec.* (1871), *p.* 35, *t.* 3, *f.* 6, *d.*

Medium size, broader than long; perfectly circular, deeply constricted with a very narrow linear sinus; semi-cells semicircular, margin crenate with 12 crenations, end view narrowly elliptic, side view dilated upwards, with the apex somewhat truncate; cell membrane about the margin obsoletely granulate-plicate, with the folds arranged in a regular concentric series.

SIZE. Length 49-52 μ; diam. 52-55 μ (L).

Archer Micr. Journ., xv. (1875), p. 412; xvii. (1877), p. 102. Nordstedt Norges Desm. (1873), p. 16. Nordstedt Desm. Arct. (1875), p. 23, 38 (var.). Nordst. & Wittr. Desm. Ital. (1876), p. 37. Wille Nov. Zem. (1879), p. 42. Nordstedt Desm. Spitz. (1872), p. 31. Nordst. Desm. Grönl. (1885), p. 7. Lemaire Desm. Vosg. (1883), p. 20.

HAB. In mountain pools and bogs.

Ireland, Lake District, Den of Gight; France, Sweden, Norway, Greenland, Italy, Spitzbergen, Nova Zembla.

Plate XL., fig. 11. *a*, living frond; *b*, empty frond; *c*, side view; *d*, end view.

Cosmarium speciosum. *Lundell Desm. Suec.* (1871), *p.* 34, *t.* 3, *f.* 5.

Of medium size, length more than 1½ times the breadth, elliptic-oblong, constricted, with a narrow linear sinus, semi-cells gradually but slightly attenuated upwards, apex subtruncate, sides very slightly convex, margin crenate, with about 18 crenations, granules arranged in a regular concentric series, with 7-8 vertical series of smaller, less distinct, granules at the base; end view elliptic, delicately granulate at each pole; side view subovate, amylaceous granule single.

SIZE. Length 54-62 μ; diam. 39-41 μ (L.); length 50-75 μ; diam. 33-50 μ (Wo.).

Archer Micr. Journ., xiii. (1873), p. 101. Nordstedt Norges Desm. (1873), p. 15. Nordstedt Desm. Arct. (1875), p. 22, 38 (var.). Nordst. & Wittr. Desm. Ital. (1876), p. 37. Wille Nov. Zem. (1879), p. 41. Nordstedt Desm. Spitz. (1872), p. 30. Jacobsen Desm. Denm. (1874), p. 195. Maskell N. Zeal. Desm. (1882), p. 240. Wille Norges Fers. (1880), p. 29. Wittr. Sottv. Alg. (1872), p. 58. Lemaire Desm. Vosg. (1883), p. 19. Wolle Desm. U.S. (1884), p. 87, t. 19, f. 7-9, 14, 15.

HAB. In pools.

Lake District; France, Sweden, Norway, Italy, Denmark, Spitzbergen, Nova Zembla, New Zealand, United States.

Plate XLI., fig. 1, *a*, living frond; *b*, empty frond; *c*, side view *d*, end view.

Cosmarium subspeciosum. *Nordst. Desm. Arct.* (1875), *p.* 22, *t.* VI., *f.* 13.

Medium size, one-third or one-fourth part longer than broad, elliptical-oblong, deeply constricted in the middle with a linear sinus, expanded outwards, semi-cells semi-circular, gradually narrowed upwards, apex faintly four-crenate, sub-truncate, sides convex, 6-7 crenate, lower angles almost rectangular, above the isthmus a tumor not much elevated, either sub-circular or elliptic, with granules in 5 or 6 series, or irregularly disposed; about the margin finely granulate, with radiating granules concentrically disposed, the two inner series, and the basal, single, the rest in pairs; side view more or less ovate, end view elliptic, apices broadly rounded, slightly swollen at the middle.

Size. Length 41-48 μ; diam. 30-36 μ; isthmus 13-16 μ (N.).

Wille Norges Fers. (1880), p. 29. Wille Nova Sem. (1879), p. 41.

Cosmarium gemmiferum, Nordst. Desm. Spitz. (1872), p. 27.

HAB. In pools.

Lake District; Norway, Nova Zembla, Spitzbergen.

Plate XLI., fig. 2. *a*, living frond; *b*, empty frond; *c*, side view; *d*, end view.

Cosmarium Wittrockii. *Lundell Desm. Suec.* 31, *t.* 3, *f.* 14.

Small, as long as broad, or a little longer, deeply constricted, sinus broad rectangular; semi-cells semi-elliptic, apex convex or truncate, end view broadly elliptic, side view circular. Cell membrane granulate, granules in longitudinal series, interrupted at the isthmus; amylaceous granule single.

SIZE. Length 18-22 μ; diam. 15-21 μ (L.); length 15 μ; diam. 12 μ (Wille); length 22 μ; diam. 22 μ (Wille); length 18-22 μ; diam. 15-21 μ (K.).

Bennett Journ. R.M.S. (1886), p. 10, t. 1, f. 15. Wille Norges Fers. (1880), p. 24. Wille Nova Sem. (1879), p. 44. Wittr. Sottv. Alg. (1872), p. 58. Kirchn. Alg. Schles. (1874), p. 152.

HAB. In mountain pools.

Lake District; Germany, Sweden, Norway, Nova Zembla.

Plate XLII., fig. 8. *a*, living frond; *b*, empty frond; *c*, side view; *d*, end view.

Cosmarium notabile. *Breb. in Pritch. Infus.* (1861), *p.* 733.

Frond about one-third longer than broad, constriction somewhat deep, acute; segments slightly longer than broad, broadest at the base, gradually narrowing upwards, sides convex, ends truncate, rough all over with broad pearly granules, giving a crenate appearance to the margin, endochrome in bands, end view oval, turgid. Zygospore orbicular, beset with numerous short stout spines, inflated at the base, and deeply divided at the apex.

SIZE. Length 33-43 μ; diam. 25-32 μ (K.); diam. 25-30 μ (Wo.).

Nordst. Norges Desm. (1873), p. 15. Nordst. & Wittr. Desm. Ital. (1876), p. 41. Wille Nova Sem. (1879), p. 36. Lemaire Desm. Vosg. (1883), p. 21. Wolle Desm. U.S. (1884), p. 79, t. 16, f. 11. Kirchn. Alg. Schles. (1878), p. 152.

var. **minor.** *Wille Nova Zem.* (1879), *p.* 36, *t.* 12, *f.* 17.

Cells in side and end views with the apices rounded.

SIZE. Length 30 μ; diam. 20 μ (Wi.).

HAB. In shallow pools.

Den of Gight; France, Germany, Norway, Italy, Nova Zembla, United States.

Plate XLII., fig 12. *a*, living frond; *b*, empty frond; *c*, end view; *d*, side view.

B. Frond not compressed, central constriction rarely a deep, never a linear, incision, but merely the result of the form of the contracted bases of the segments; end view circular or rarely compressed.

⁂ *Frond rough.*

Cosmarium orbiculatum. *Ralfs. Ann. Nat. Hist.* (1844), XIV., *p.* 392, *t.* 11, *f.* 2.

Frond minute, in front view twice as long as broad; constriction deep; segments sphærical, rough all over, except at the neck-like contraction, with pearly granules; end view circular. Zygospore orbicular, spiny.

SIZE. Diam. 20-33 μ (Wo.); length 39 μ; diam. 28 μ (D.).

Ralfs. Desm. (1848), p. 107, t. 17, f. 5; t. 33, f. 9. Archer in Prit. Inf. (1861), p. 735. Hassall Fr. Alg. (1845), p. 364 Nordst. Desm. Grönl. (1885), p. 9. Delponte Desm. (187 7, f. 46-48. Wolle Desm. U.S. (1884), p. 77, t. 14, f. 2 Lundell Desm. Suec. (1871), p. 46. Nordstedt Norges I ... (1873), p. 22. Wittrock Scan. Desm. (1869), 14. Brebisson Liste Desm. (1856), p. 132. Rabh. Alg. Eur. (1868), p. 173. Wille Norges Fers. (1880), p. 37. Lemaire Desm. Vosg. (1883), p. 21. Kirchn. Alg. Schles. (1878), p. 153.

Penium orbiculatum, Kutz.

HAB. In pools.

Sussex, Westmoreland, Wales, Cornwall; France, Germany, Norway, Sweden, Greenland, Italy, United States.

Plate XLIII., fig. 1. *a c*, living fronds; *b d*, empty fronds; *e*, end view; *f*, zygospore.

⁂ *Frond smooth.*

Cosmarium moniliforme. (*Turp.*) *Ralfs. Desm.* (1848), *p.* 107, *t.* 17, *f.* 6.

Frond minute, in front view twice as long as broad, constriction deep; segments sphærical, smooth; end view circular. Zygospore globose, smooth.

SIZE. Length 26 μ; diam. 16-21 μ (N.); diam. 16-24 μ (Wo.); length 25-36 μ; diam. 18 μ (D.); zygospore 37 μ (L.).

Wolle Desm. U.S. (1884), p. 60, t. 15, f 16-19. Archer in

Prit. Inf. (1861), p. 735. Delponte Desm. (1878), t. 7, f. 40-45.? Cleve Sver. Desm. (1864), p. 488. Lundell Desm. Suec. (1871), 44. Nordst. Desm. Braz. (1869), p. 214. Nordstedt. Norges Desm. (1873), p. 21. Brebisson Liste Desm. (1856), p. 132. Klebs. Desm. Pruss. (1879), p. 37 (var. a.). Wille Norges Fers. (1880), p. 37. Schaarschm. Magy. Desm. (1883), p. 270. Lemaire Desm. Vosg. (1883), p. 21. Wittrock Scan. Desm. (1869), p. 14. Rabh. Alg. Eur. (1868), p. 173. Jacobsen Desm. Denm. (1874), p. 200. Kirchner Alg. Schles. (1878), p. 147.

Tessarthronia moniliformis, Turp. Dict. Sci. Nat. (1820), t. 7, f. 1.

Tessarthra moniliformis, Ehr. Abh. Berl. Ak. (1835), p. 173. Ehr. Inf., p. 145, t. 10, f. 20.

HAB. In ponds.

Sussex, Lancashire, Wales, Cornwall; France, Germany, Norway, Sweden, Denmark, Hungary, Italy, United States.

Plate XLIII., fig. 2. *a*, living frond; *b*, empty frond; *c*, end view; *d*, zygospore.

Cosmarium Jacobseni. *Roy. in Micr. Jour.* (1884), *Vol.* IV., *p.* 194.

Small, about twice as long as broad, with an acute-angled deep incision, semi-cells oval, broader than long, side view orbicular; membrane smooth, at first with a gelatinous envelope.

SIZE. Length 45 μ; diam. 26-27 μ (J.).

Cosmarium moniliferum, Jacobsen Desm. Denm, p. 200, t. 8, f. 24.

HAB. In mountain pools.

Lake District (England); Denmark.

Plate XLIII., fig. 3. *a*, living frond; *b* empty frond; *c*, side view.

Cosmarium parvulum. *Breb. Liste Desm.* (1856), *p.* 133, *t.* 1, *f.* 18.

Frond minute, in front view ovato-elliptic, about one and a half times longer than broad; central constriction a very shallow groove; segments tapering, ends broadly rotundato-truncate, cell membrane smooth, or rarely very delicately punctate.

SIZE. Length 44-49 μ; diam. 18-19 μ (L.); length 28-34 μ; diam. 15-17 μ (N.); diam. 18-22 μ (Wo.).

Archer in Prit. Infus. (1861), p. 735. Nordst. Desm.

Arct. (1875), p. 27, t. 7, f. 21. Nordst. Desm. Braz. (1869), p. 215. Lundell Desm. Suec. (1871), p. 50. Nordst. Norges Desm. (1873), p. 24. Wolle Desm. U.S. (1884), p. 59, t. 18, f. 12, 13.

HAB. In pools.

Lake District; France, Sweden, Norway, Nova Zembla, Brazil, United States.

Plate XLIII., fig. 8. *a*, living frond; *b*, empty frond; *c*, side view.

Cosmarium lobatosporum. *Archer in Micr. Journ.* (1867), VII., *p.* 171.

Frond very minute, nearly twice as long as broad, general form elliptic; ends rounded, constriction an extremely shallow and very gentle narrowing. Zygospore rounded, somewhat irregularly lobed; the lobes surmounted by one or two minute pellucid conical and pointed spines or mucrones; cell wall reddish.

SIZE. Length 15 μ; diam. 10 μ; zygospore 25 μ (Ar.).

Rabh. Alg. Eur. (1868), p. 179.

HAB. In bog pools.

Ireland.

Cosmarium globosum. *Buln. in Hedwigia* (1861), *p.* 52, *t.* 9, *f.* 8.

Small, greenish yellow, sub-circular, scarcely compressed, about one-third longer than broad, very slightly constricted with an acute sinus; semi-cells circular except at the confluent base, quite entire; cell membrane even, finely punctate.

SIZE. Length 30-34 μ; diam. 20-22 μ (L.); length 29-32 μ; diam. 21-24 μ (Wille); length 25-33 μ; diam. 20-24 μ (Wo.).

Rabh. Alg. Eur. (1868), iii., 178. Lundell Desm. Suec. (1871), p. 45. Nordst. Norges Desm. (1873), p. 22. Jacobsen Desm. Denm. (1874), p. 201. Nordst. Desm. Grönl. (1885), p. 9. Nordst. Desm. Arct. (1875), p. 28. Wille Nova Sem. (1879), p. 45. Lemaire Desm. Vosg. (1883), p. 21. Wolle Desm. U.S. (1884), p. 60, t. 49, f. 14-17.

HAB. In bogs.

France, Scotland, Germany, Sweden, Norway, Denmark, Greenland, Nova Zembla, Spitzbergen, United States.

Plate XLIII., fig. 6. *a*, living frond; *b*, empty frond; *c*, end view; *l*, living frond of another form; *e*, empty frond.

GEN. 18. CALOCYLINDRUS. *De Bary* (1858).

Cells straight, cylindrical, oval, or spindle-shaped; ends rounded or truncate, central contriction almost obsolete, or very shallow; semi-cells without basal inflation, or longitudinal plication; chlorophyll parietal or axillary.

* *Frond rough.*

Calocylindrus cylindricus. (*Ralfs.*)

Frond minute, in front view about twice as long as broad, segments subquadrate, narrower at the junction and gradually widening upwards, ends truncate, rough all over with pearly granules somewhat arranged in lines; end view circular.

SIZE. Length 57 μ; diam. 21 μ (D); length 40 μ; diam. 24 μ (K.).

Cosmarium cylindricum, Ralfs. Ann. Nat. Hist. (1844), xiv., p. 392, t. 11, f. 1. Ralfs. Desm. (1848), p. 106, t. 17, f. 4. Archer in Prit. Inf. (1861), p. 734, t. 3, f. 16-17. Hassall Fr. Alg. (1845), p. 365. Brebisson Liste Desm. (1856), p. 132. Rabh. Alg. Eur. (1868), p. 176. Wille Nov. Sem. (1879), p. 47. Wille Norges Fers. (1880), p. 36.

Calocylindrus Ralfsii. Kirchn. Alg. Schles. (1878), p. 142. Wolle Desmi. U.S. (1884), p. 54, t. 12, f. 17.

Penium Ralfsii, Kutz. Sp. Alg. (1849), p. 167. Delponte Desm. (1878), p. 90, t. 15, f. 26-28.

HAB. On wet rocks and cliffs.

Sussex, Cornwall, Wales; France, Germany, Norway, Nova Zembla, Italy, United States.

Plate XLIII., fig. 1-4. *a*, living frond; *b c*, empty fronds; *d*, end view.

Calocylindrus annulatus. *De Bary Conj.* (1858), *p.* 72.

Frond minute, scarcely twice as long as broad, cylindrical or subelliptic, sides and broadly rounded ends rough with minute granules arranged in transverse lines, which give a minutely denticulate appearance to the margin, except at a very narrow central circular annular space, where they are absent, thus imparting a somewhat constricted appearance; end view circular, margin minutely granulated.

SIZE. Diam. 20 μ (K.); length 40-52 μ; diam. 18-22 μ (N. & W.).

Schaarschm. Magy. Desm. (1883), p. 271. Kirchn. Alg. Schles. (1878), p. 143.

Cosmarium annulatum, Archer Micr. Journ. (1870), p. 92. Lundell Desm. Suec. (1871), p. 46. Wittr. Norges Fers. (1880),

p. 38. Nordstedt Norges Desm. (1873), p. 23. Nordstedt Desm. Arct. (1875), p. 30. Nordst. & Wille Desm. Ital. (1876), p. 42. Wille Nov. Sem. (1879), p. 49. Lemaire Desm. Vosg. (1883), p. 21. Jacobsen Desm. Denm. (1874), p. 196.

Dysphinctium annulatum, Nag. Einz. Algen. (1849), p. 110, t. 6, f. F.

Penium annulatum, Archer in Pritch. Inf. (1861), p. 751. Cleve Sver. Desm. (1864), p. 493. Rabh. Alg. Eur. (1868), iii., p. 122.

HAB. In pools, &c.

Ireland, Lake District, Scotland; France, Germany, Norway, Sweden, Denmark, Italy, Hungary, Spitzbergen, Nova Zembla.

Plate XLIII., fig. 15. *a b c*, living fronds; *d*, empty frond; *e*, end view; *f*, empty frond further magnified.

Calocylindrus tuberculatus. (*Archer.*)

Frond very minute, constriction very obtuse and shallow; segments in front view broadly elliptic, outward margin bordered by a few very minute opaque tubercles or granules; end view broadly elliptic.

SIZE. Length 14-24 μ; diam 9-11 μ.

Cosmarium tuberculatum, Archer in Micr. Journ. (1862), ii., p. 247, t. 12, f. 11-15. Rabh. Alg. Eur. (1868), p. 178.

HAB. In small pools.

Ireland.

Plate XLIII., fig 13. *a c*, living fronds; *b d*, empty fronds; *e*, end view; *f*, empty frond further magnified.

** *Frond smooth.*

Calocylindrus oblongus. (*Bennett.*)

Minute, two and a half times as long as broad, with a broad constriction in the middle, semi-cells elliptical, longer than broad, equally rounded at the base and the apex. Membrane smooth.

SIZE. Length 55 μ; diam. 22 μ (B.).

Cosmarium sp. Reinsch. Cont., 82, t. 42, f. 3.

Cosmarium oblongum. Bennett Journ. Roy. Micr. Soc. (1886), p. 10, t. 1, f. 16.

HAB. In bog pools.

Lake District (England).

Plate XLIV., fig. 8. *a*, living frond; *b*, empty frond after Bennett.

Calocylindrus connatus. *Kirchn. Alg. Schles.* (1878), *p.* 142.

Frond large, in front view about one half longer than broad, constriction shallow; segments about two-thirds of a circle, coarsely punctate, and with a distinct, sometimes striated, border; end view circular.

SIZE. Length 72 μ; diam. 43 μ (D.); length 70-102 μ; diam. 45-75 μ (K.); diam. 45-75 μ (Wo.).

Schaarschm. Magy. Desm. (1883), p. 271. Wolle Desm. U.S. (1884), p. 55, t. 11, f. 8, 9.

Dysphinctium Meneghinianum, Näg. Einz. Alg. (1849), t. 6 G, f. 2.

Cosmarium connatum, Breb. in Ralfs. Desm. (1848), p. 108, t. 17, f. 10. Archer in Prit. Inf. (1861), p. 735. Delponte p. Desm. (1878), t. 9, f. 23-25. Cleve Sver. Desm. (1864), 488. Lundell Desm. Suec. (1871), p. 45. Nordstedt Norges Desm. (1873), p. 22. Grunow Desm. Austr. (1858), p. 501. Wood F. Water Algæ U.S. (1871), p. 154. Brebisson Liste Desm. (1856), p. 132. Wille Norges Fers. (1880), p. 38. Lemaire Desm. Vosg. (1883), p. 21. Wittrock Scan. Desm. (1869), p. 14. Notaris Desm. Ital. (1867), p. 39, t. 3, f. 20. Rabh. Alg. Eur. (1868), p. 175. Jacobsen Desm. Den. (1874), p. 201.

Cosmarium connatum a typicum, Klebs. Desm. Pruss. (1879), p. 29.

HAB. In pools, &c.

Westmoreland, Wales; France, Germany, Sweden, Norway, Austria, Hungary, Italy, United States.

Plate XLIV., *fig.* 2. *a*, living frond; *b*, empty frond; *c*, end view.

Calocylindrus pseudo-connatus. *Nordst.*

Medium size, oval, somewhat fiddle-shaped, slightly sinuately constricted at the middle, broadly rounded at each pole, circumference quite entire; end view orbicular, semi-cells sub-hemispherical; membrane delicately punctate, colourless or slightly brownish.

SIZE. Length 43 μ; diam. 28 μ; isthmus 25 μ (N.); length 55 μ; diam. 44 μ (L.).

Wolle Desm. U.S. (1884), p. 55, t. 12, f. 11; t. 49, f. 10, 11.

Cosmarium pseudo-connatum, Nordstedt Desm. Braz. (1869), p. 214, t. 3, f. 17. Nordstedt Norges Desm. (1873), p. 24. Lundell Desm. Suec. (1871), p. 45. Archer in Journ. Bot. (1874), iii., p. 93.

Cosmarium connatum b. pseudo-connatum, Klebs. Desm. Pruss. (1879), p. 29.

HAB. In marshy pools.

Ireland, Lake District; Sweden, Norway, Brazil, United States.

Plate XLIV., fig. 3. *a*, living frond; *b*, empty frond; *c*, end view.

Calocylindrus cucurbita. *DeBary Conj.* (1858), *p.* 72.

Frond in front view about twice as long as broad; constriction a shallow groove; segments sub-cylindrical, or somewhat oval, with rounded ends; end view circular; empty frond punctate, with scattered puncta.

SIZE. Diam. 22-25 μ (K.); diam. 22-25 μ (Wo.); length 30-34 μ; diam. 18-18½ μ (L.).

Schaarschm. Magy. Desm. (1883), p. 271. Kirchn. Alg. Schles. (1878), p. 143. Wolle Desm. U.S. (1884), p. 54, t. 12, f. 15, 16.

Penium clandestinum, Kutz.

Cosmarium cucurbita, Breb. in Desm. Alg. No. 1103 (1840). Ralfs. Ann. Nat. Hist. (1844), xiv., p. 395, t. 11, f. 10. Ralfs. Desm. (1848), p. 108, t. 17, f. 7. Archer in Prit. Inf. (1861), p. 735. Cleve Sver. Desm. (1864), p. 488. Lundell Desm. Suec. (1871), p. 51. Nordstedt Norges Desm. (1873), p. 24. Grunow Desm. Austr. (1858), p. 500. Wittrock Scan. Desm. (1869), p. 14. Brebisson Liste Desm. (1856), p. 132. Rabh. Alg. Eur. (1868), p. 174. Lemaire Desm. Vosg. (1883), p. 22. Jacobsen Desm. Denm. (1874), p. 201.

Cosmarium cucurbita a. typicum, Klebs. Desm. Pruss. (1879), p. 28.

HAB. In ponds, &c.

Sussex, Hants, Gloucester, Cheshire, Westmoreland, Cornwall, Wales, Ireland; France, Germany, Sweden, Norway, Austria, Hungary, United States.

Plate XLIV., fig 7. *a*, living frond; *b c*, empty fronds; *e*, end view.

Calocylindrus palangula. *De Bary Conj.* (1858), *p.* 72.

Frond in front view about two and a half times as long as broad, constriction a shallow groove, segments cylindrical, ends obtuse; end view circular, empty frond minutely punctate, the puncta arranged in transverse lines.

SIZE. Diam. 12-15 μ (K.).

Schaarschm. Magy. Desm. (1883), 271. Kirchn. Alg. Schles. (1878), p. 143.

Cosmarium palangula, Breb. Liste Desm. (1856), p. 132. Archer in Prit. Infus. (1861), p. 734. Lundell Desm. Suec.

(1871), p. 51. Wille Norges Fers. (1880), p. 37. Lemaire. Desm. Vosg. (1883), p. 22.

HAB. In ponds, pools, &c.

France, Germany, Sweden, Norway, Italy, Hungary.

Plate XLIV., fig. 9. *a*, living frond; *b*, empty frond.

Calocylindrus Thwaitesii. (*Ralfs.*)

Frond in front view two or three times longer than broad, constriction a very shallow groove; segments subcylindrical, with rounded ends; endochrome scattered; end view circular, or very slightly compressed; empty frond not punctate, or puncta very indistinct.

SIZE. Diam. 30 μ (Wo.); length 58-72 μ; diam. 28-30 μ (L.).

Schaarschm. Magy. Desm. (1883), p. 271. Wolle Desm. U.S. (1884), p. 56, t. 12, f. 19; t. 50, p. 28.

Penium Thwaitesii, Cleve Sver. Desm. (1864), p. 492.

Cosmarium Thwaitesii, Ralfs. Desm. (1848), p. 109, t. 17, f. 8. Brebisson Liste Desm. (1856), p. 132. Archer in Prit. Inf. (1861), p. 735. Lundell Desm. Suec. (1871), p. 47. Wood F. Water Algæ U.S. (1872), p. 134. Wittrock Scan. Desm. (1869), p. 14. Rabh. Alg. Eur. (1868), p. 175. Maskell N. Zeal. Desm. (1882), p. 239. Wille Norges Fers. (1880), p. 37. Lemaire Desm. Vosg. (1883), p. 22.

Cosmarium Thwaitesii a. typicum, Klebs. Desm. Pruss. (1879), p. 26.

HAB. In ponds.

Gloucester, Wales, Lake District; France, Germany, Sweden, Norway, Italy, Hungary, New Zealand, United States.

Plate XLIV., fig. 5. *a*, living frond; *b*, empty frond; *c*, end view.

Calocylindrus curtus. *De Bary Conj.* (1858), *p.* 72.

Frond in front view rather more than twice as long as broad, constriction very shallow; segments attenuated and rounded at ends; endochrome in fillets; end view circular, endochrome radiate.

SIZE. Diam. 26 μ (K.); diam. 20-32 μ (Wo.).

Kirchn. Alg. Schles. (1878), p. 143. Wolle Desm. U.S. (1884), p. 54, t. 12, f. 15, 16.

Penium curtum, Breb. in litt. fide Ralfs. Archer in Micr. Journ. xvi. (1876), p. 236. Nordstedt Norges Desm. (1873), p. 45. Cleve Sver. Desm. (1864), p. 493. Nordstedt Desm. Spitz. (1872), p. 25. Wille Nov. Zem. (1879), p. 56. Nordstedt Desm. Arct. (1875), p. 15.

Dysphinctium Regelianum, Näg. Einz. Alg. (1849), t. 6, E.

Cosmarium curtum, Breb. in Meneg. Syn. Desm. (1840), p. 237. Ralfs. Desm. (1848), p. 109, t. 32, f. 9. Archer in Prit. Inf. (1861), p. 735. Brebisson Liste Desm. (1856), p. 133. Rabh. Alg. Eur. (1868), p. 176 (sine var. c.).

Cosmarium Thwaitesii d. curtum, Klebs. Desm. Pruss. (1879), p. 27.

HAB. In pools.

Gloucester, Cornwall, Ireland ; France, Germany, Norway, Sweden, Spitzbergen, Nova Zembla, Italy, United States.

Plate XLIII., fig. 11. *a c*, living fronds ; *b d*, empty fronds ; *e*, end view.

Calocylindrus attenuatus. *(Breb.)*

Frond in front view fusiform, three or sometimes four times longer than broad ; constriction very shallow ; segments conical, rapidly attenuated, ends angular, obtuse ; end view circular ; empty frond punctate.

SIZE. Length 58 μ ; diam. 34 μ (N.).

Cosmarium attenuatum, Breb. in Ralfs. Desm. (1848), p. 110, t. 17, f. 9. Archer in Prit. Inf. (1861), p. 735. Nordstedt Desm. Arct. (1875), p. 27. Nordstedt Norges Desm. (1873), p. 24. Wittrock Scan. Desm. (1869), p. 15. Brebisson Liste Desm. (1856), p. 133.

Cosmarium curtum var. *C. majus*, Rabh. Alg. Eur. (1868), p. 177.

Closterium Thwaitesii d. curtum form j., Klebs. Desm. Pruss. (1879), p. 27.

HAB. In pools, &c.

Gloucester, Wales ; France, Norway, Spitzbergen.

Plate XLIII., fig. 12. *a c*, living fronds ; *b d*, empty fronds ; *e*, end view.

Calocylindrus turgidus. *Kirch. Alg. Schles.* (1878), *p.* 142.

Frond very large, in front view oval, turgid, rather more than twice as long as broad ; constriction a shallow sinus ; segments somewhat tapering, broadly rounded ; end view circular; empty frond punctate.

SIZE. Length 187-216 μ ; diam. 72-82 μ (D.); diam. 100 μ (K.).

Cosmarium turgidum, Breb. in Ralfs. Desm. (1848), p. 110, t. 32, f. 8.

Archer in Prit. Inf. (1861), p. 735. Lundell Desm. Suec.

(1871), p. 51. Grunow Desm. Austr. (1858), p. 500. E bisson Liste Desm. (1856), p. 123. Jacobsen Desm. Dei (1874), p. 201. Lemaire Desm. Vosg. (1883), p. 22.

Docidium turgidum, Wittrock Scan. Desm. (1869), p. Petit Liste Desm. Paris (1877), p. 29.

Dysphinctium turgidum, Delponte Desm. (1878), p. 133, t. f. 1-6.

Pleurotenium turgidum, De Bary Conj. (1858), t. 5, f. 3 Cleve Sver. Desm. (1864), p. 493; Rabh. Alg. Eur. (1868), 144.

Cosmarium DeBaryi c. turgidum, Klebs. Desm. Pruss. (187 p. 28.

Hab. In pools, &c.

Sussex, Wales, Lake District; France, Germany, Swed Denmark, Italy, Austria.

Plate XLIV., fig. 1. *a*, living frond; *b*, empty frond; *c*, end vie

Calocylindrus DeBaryi. *(Archer.)*

Frond in front view about twice as long as broad; co striction a wide shallow notch; segments cylindrical, wi broadly rounded ends, endochrome arranged in parietal i dented bands; end view circular; empty frond minute punctate, or without puncta.

Size. Length 95 μ; diam. 45 μ; length 104-110 μ; dia 50-54 μ (Wo.); length 104-112 μ; diam. 50-54 μ (L.).

Pleurotenium cosmarioides, De Bary Conj. (1858), t. 5, 32, 33. Rabh. Alg. Eur. (1868), p. 144. Clev. Sver. Des (1864), p. 493.

Cosmarium DeBaryi, Archer in Prit. Inf. (1861), p. 73 Wolle Desm. U.S. (1884), p. 58, t. 15, f. 5. Archer in Mic Journ. (1871), p. 211. Lundell Desm. Suec. (1871), p. 5 Nordstedt Norges Desm. (1873), p. 25. Nordstedt Des Arct. (1875), p. 29. Wille Nov. Sem. (1879), p. 48. Jaco sen Desm. Denm. (1874), p. 201. Kirchner Alg. Schle (1878), p. 146. Wille Norges. Fers. (1880), p. 38.

Cosmarium DeBaryi a. typicum. Klebs. Desm. Prus (1879), p. 28.

Hab. In mountain pools.

Ireland, Lake District; Germany, Sweden, Norway, Der mark, Spitzbergen, Nova Zembla, United States.

Plate XLIV., fig. 4. *a*, living frond; *b*, empty frond.

Calocylindrus strangulatus. *Cke. and Wills.*

Minute, two-thirds longer than broad, bi-spherical, with a acute angular constriction in the middle, side view a doubl oval, end view circular, semi-cells globose, confluent at the base, membrane smooth.

Size. Length 35 μ; diam. 20-22 μ (C.).

In mountain pools.

N. Wales.

Plate XLIV., fig. 10. *a*, living frond; *b*, empty frond; *c*, side view; *d*, end view.

Calocylindrus pseudarctoum. *(Nordst. in Wittr. and Nordst. Algæ. Exs. No. 257.)*

Small, about one-fourth part longer than broad, very slightly excavated at the middle, side view elliptical semi-cells in front view broadly ovate, apex truncate, upper angles broadly rounded, end view circularly elliptic.

Size. Length 17-21 μ; diam. 14-16 μ; isthmus 13½-15 μ (N.).

Cosmarium pseudar
Algæ Exs. No. 257.

Hab. Amongst mos

Den of Gight; Nor

Plate XLIV., fig. 6. *a*, living frond; *b*, empty frond; *c*, end view.

Gen. 19. XANTHIDIUM. *Ehr.* (1832).

Frond deeply constricted, segments broader than long, compressed, entire, spinous, having a circular cylindrical, or conical, rojection on both surfaces near the centre, which is tuberculated r dentate, or entire; end view elliptic.

Xanthidium armatum. *Breb. in Ralfs. Desm.* (1848), *p.* 112, t. 18.

Frond large, in front view twice as long as broad, constriction leep, linear; segments broadest at the base; ends rounded, or omewhat truncate; spines in pairs, principally marginal, short, tout, terminated by three or four diverging points; central proections cylindrical, truncate, the border dentate; empty frond unctate. Zygospore large, subglobose, scrobiculate.

Size. Length 180-200 μ; diam. 90-110 μ; zygospore 100-08 μ (K.); diam. 62-140 μ (Wo.).

Archer in Prit. Inf. (1861), p. 735, t. 1, f. 27, 28. Micr. ourn. xiii. (1873), p. 311. Cleve Sver. Desm. (1864), p. 491. undell Desm. Suec. (1871), p. 75, t. 5, f. 4. Nordstedt orges Desm. (1873), p. 37. Petit Liste Desm. Paris (1877), 32. Wittrock Scan. Desm. (1869), p. 19. Wood F. Water

Algæ U.S. (1872), p. 156. Kirchn. Alg. Schles. (1878), p. 154. Wolle Desm. U.S. (1884), p. 92, t. 21, f. 1-4. Brebisson Liste Desm. (1856), p. 134. Notaris Desm. Ital. (1867), p. 47, t. 4, f. 35. Rabh. Alg. Eur. (1868), p. 222. Jacobsen Desm. Denm. (1874), p. 209.

Cosmarium armatum, Breb. in Meneg. Syn. Desm. (1840), p. 218.

Xanthidium furcatum, Ralfs. Ann. Nat. Hist. (1844), xiv., p. 466, t. 12, f. 1. Hassall Fr. W. Alg. (1845), p. 359.

Euastrum armatum, Kutz. Phy. Germ. (1845), p. 137.

HAB. In ponds.

Widely distributed. Kent, Sussex, Hants, Herts, Norfolk, Westmoreland, Cornwall, Wales, Scotland, Ireland; France, Germany, Sweden, Norway, Denmark, Italy, United States.

Plate XLV., fig. 1. *a*, living frond; *b*, empty frond; *c*, side view; *d*, end view; *e*, empty semi-cell; *f*, zygospore.

Xanthidium aculeatum. *Ehr. Abh. Berl. Akad.* (1833), *t.* 10, *f.* 23.

Frond in front view broader than long; constriction deep, linear; segments somewhat reniform; spines subulate, short, scattered, chiefly marginal, central protuberance cylindrical, truncate, border minutely dentate. Zygospore large, orbicular, beset with spines which are broad at the base, tapering upwards to the blunt and uncinate extremities.

SIZE. Diam., without spines, 63-71 μ; spines 33 μ; zygospore 66-70 μ (K.); diam. 62-70 μ (Wo.).

Ralfs. Desm. (1848), p. 113, t. 19, f. 1. Kirchn. Alg. Schles. (1878), p. 155. Archer in Prit. Inf. (1861), p. 736. Hassall Fr. W. Alg. (1845), p. 360. Rabh. Alg. Eur. (1868), p. 222. Cleve Sver Desm. (1864), p. 491. Lundell Desm. Suec. (1871), p. 75. Nordstedt Norges Desm. (1873), p. 38. Wittrock Scan. Desm. (1869), p. 19. Breb. Liste Desm. (1856), p. 134. Wood F. Water Algæ U.S. (1872), p. 156. Wolle Desm. U.S. (1884), p. 92, t. 23, f. 10-12.

Zygoxanthum aculeatum, Kutz. Sp. Alg. (1849), p. 178.

HAB. In boggy pools.

Hants, Sussex, Kent, Gloucester, Cornwall; France, Germany, Sweden, Norway, Italy, United States.

Plate XLV., fig. 2. *a*, living frond; *b*, empty frond; *c*, side view; *d*, end view.

Plate XLIII., fig. 10. Zygospore.

Xanthidium Brebissonii. *Ralfs. Desm.* (1848), *p.* 113, *t.* 19. *f.* 2.

Frond in front view broader than long; constriction deep, acute, not linear; segments subelliptic, sometimes irregular;

spines subulate, geminate, marginal; central protuberance cylindrical, truncate, border minutely dentate.

SIZE. Without spines 65-70 × 60 μ.

Rabh. Alg. Eur. (1868), p. 223. Archer in Prit. Inf. (1861), p. 736. Nordstedt Norges Desm. (1873), p. 38. Petit Liste Desm. Paris (1877), p. 32. Brebisson Liste Desm. (1856), p. 134.

Binatella aculeata, Breb. Alg. Fal. (1835), p. 58, t. 8.

Cosmarium aculeatum, Meneg. Syn. Desm. (1840), p. 218, in part.

Xanthidium bisenarium, Ehr. Mikr. Leb. N. & S. Am. (1843).

Zygoxanthium aculeatum, Kutz. Sp. Alg., p. 178, *pro parte*.

var. *β*. **varians.** *Ralfs. Desm.* (1848), *p.* 113.

Segments broader and more irregular, spines somewhat irregular and unequal.

HAB. In ponds, &c.

Sussex, Gloucester, Cornwall; France, Germany, Norway, Italy.

Plate XLV., fig. 3. *a*, living frond; *b*, empty frond; *c*, end view.

Xanthidium fasciculatum. *Ehr. Infus.* (1838), *t.* 10, *f.* 24.

Frond about as long as broad; constriction deep, linear; segments somewhat reniform, or sub-hexagonal, twice as broad as long; spines slender, subulate, geminate, marginal, in six pairs; central protuberance short, conical, somewhat truncate. Zygospore orbicular, large, beset with long tapering bifid spines.

SIZE. Diam., without spines, 55-63 μ; length, 60-77 μ (K.); diam. 55-65 μ (Wo.); length 43-68 μ; diam., 39-72 μ (D.)

Ralfs. Ann. Nat. Hist. (1844), xiv., p. 467, t. 12, f. 3, *a b c d*. Ralfs. Desm. (1848), p. 114, t. 20, f. 1; t. 19, f. 4. Archer in Prit. Inf. (1861), p. 736. Kirchn. Alg. Schles. (1878), p. 155. Delponte Desm. (1878), t. 13, f. 20-26. Cleve Sver. Desm. (1864), p. 491. Breb. Liste Desm. (1856), p. 134. Lundell Desm. Suec. (1871), p. 75. Nordstedt Norges Desm. (1873), p. 38. Hass. F. W. Alg. (1845), p. 359. Petit Liste Desm. Paris (1877), p. 32. Wittrock Scan. Desm. (1869), p. 19. Wood F. Water Algæ U.S. (1872), p. 157. Notaris Desm. Ital. (1867), p. 48, t. 4, f. 36. Rabh. Alg. Eur. (1868), p. 223. Wolle Desm. U.S. (1884), p. 93, t. 22, f. 4, 5. Jacobsen Desm. Denm. (1874), p. 210.

Euastrum fasciculatum, Kutz. Phy. Germ. (1845), p. 137.

Xanthidium polygonum, Hassall Fr. Alg. (1845), p. 360.

Xanthidium fasciculatum, var. *polygonum*, Ehr. Infus. (1838), t. 10, f. 24, *b*.

HAB. In pools, ponds, &c.

Sussex, Hants, Gloucester, Cornwall, Cheshire, Norfolk, Westmoreland, Lancashire, Wales, Scotland; France, Germany, Sweden, Norway, Denmark, Italy, United States.

Plate XLVI., fig. 1. *a*, living frond; *b c*, empty fronds; *d*, end view; *e*, side view.

Xanthidium antilopeum. *Breb. Liste Desm.* (1856), *p.* 134.

With the habit of *X. fasciculatum*, but with each segment furnished with four pairs of spines.

SIZE. Length, without spines, 75 μ; diam. 75 μ; zygospore 58 μ (K.); diam. 45-50 μ (Wo.).

Kutz. Sp. Alg. (1849), p. 177. Lundell Desm. Suec. (1871), p. 75. Nordst. Norges Desm. (1873), p. 38. Petit Liste Desm. Paris (1877), p. 32. Kirchner Alg. Schles. (1878), p. 155. Wolle Desm. U.S. (1884), p. 94, t. 23, f. 1, 2.

Xanthidium fasciculatum, var. *antilopeum*, Rabh. Alg. Eur. (1868), p. 223. Jacobsen Desm. Denm. (1874), p. 210. Ralfs. Desm. (1848), p. 114, t. 20, f. 1.

Cosmarium antilopeum, Breb. in Meneg. Syn. Desm. (1840), p. 218.

HAB. In ponds.

France, Germany, Sweden, Norway, United States.

Plate XLVI., fig. 2. *a*, living frond; *b*, empty fronds; *c*, end view; *d*, side view.

Xanthidium spinulosum. *Bennett Journ. Roy. Micr. Soc.* (1886), *p.* 10, *t.* 2, *f.* 17.

Frond moderately large, the shape of *X. fasciculatum*; each frustule elliptical, or slightly hexagonal, furnished with four pairs of geminate curved spines about 25 μ long, the whole of the rest of the edge ciliated with closely-set spines or teeth. Endochrome very granular, with a lighter, less granular portion in the centre of each frustule.

SIZE. Semi-cells 80 × 40 μ; isthmus 60 μ (B.).

HAB. Mountain streams.

Lake District (England).

A doubtfully distinct species.

Plate XLVI., fig. 4. Living frond, after Bennett.

Xanthidium cristatum. *Breb. in Ralfs. Desm.* (1848), *p.* 115, *t.* 19, *f.* 3.

Frond rather longer than broad; constriction deep; segments subreniform, or truncate at ends, spines straight or curved, subulate, marginal, one at each side, at the base of the segment, solitary, the others geminate, in four pairs; central protuberance short, conical.

SIZE. Length 57 μ; diam. 55 μ (D.); diam., without spines, 50 μ; zygospore 51 μ (K.); diam. 40-55 μ (Wo.).

Archer in Prit. Inf. (1861), p. 736, t. 2, f. 18 & 23. Delponte Desm. (1878), t. 14, f. 1-12. Cleve Sver. Desm. (1864), p. 491. Kirchner Alg. Schles. (1878), p. 155. Lundell Desm. Suec. (1871), p. 76. Nordstedt Norges Desm. (1873), p. 38. Wolle Desm. U.S. (1884), p. 93, t. 21, f. 5-8. Petit Liste Desm. Paris (1877), p. 32. Wittrock Scan. Desm. (1869), p. 19. Wood F. Water Algæ. U.S. (1872), p. 157. Brebisson List. Desm. (1856), p. 135. Rabh. Alg. Eur. (1868), p. 224. Jacobsen Desm. Denm. (1874), p. 210.

HAB. In ponds.

Sussex, Westmoreland, Cornwall, Wales, Scotland; France, Germany, Sweden, Norway, United States.

Plate XLVI., fig. 3. *a c*, living fronds; *b f*, empty fronds; *d*, side view; *e*, end view; *g*, zygospore.

var. *a.* **reniforme.** *Ralfs. Desm.* (1848), *p.* 115.

Segments reniform, spines scarcely curved.

Xanthidium cristatum, Breb. in litt. (1846).

HAB. In ponds, &c.

Lake District, England, Sussex, Wales, Scotland.

var. *β.* **uncinatum.** *Breb. in Ralfs. Desm.* (1848), *p.* 115, *t.* 19, *f.* 3, *d e f.*

Segments truncate at the ends, spines uncinate.

Lundell Desm. Suec. (1871), p. 76. Nordstedt Norges Desm. (1873), p. 38. Brebisson Liste Desm. (1856), p. 135. Rabh. Alg. Eur. (1868), p. 224.

HAB. In ponds, &c.

Westmoreland, Wales; France, Sweden, Norway.

Xanthidium Smithii. *Archer in Pritch. Infus.* (1861), *p.* 736.

Frond minute, in front view about as long as broad, constriction a wide notch, segments twice as broad as long, trapezoid; angles rounded, each presenting a pair of somewhat divergent, short, minute, acute spines; central protuberance a minute tubercle.

SIZE. Length 21 μ; diam. 19 μ [illegible]

Archer Micr. Journ. (18[illegible]), [illegible] 11, [illegible] Alg. Eur. (1868), p. 224.

HAB. In ponds.

Wareham.

Plate XLV., fig. 4. *a c*, living fr[illegible] *f*, side view.

Xanthidium Robinsonianum. [illegible] p. 11[illegible]

Small, semi-cells trapezoid, th[illegible] few minute spines; central elevati[illegible] few irregularly disposed, rather [illegible] margins straight, isthmus slightly [illegible] forming a parallel and straight [illegible]

SIZE. Not given.

HAB. In pools.

Ireland.

We have not seen this species, whic[illegible] scribed, and no figure published.

GEN. 20. **ARTHRODESMUS.** [illegible]

Frond deeply constricted; [illegible] with four prominent angle[illegible], and [illegible] or a tooth, at each angle, or havin[illegible] only, on each side, at each upper [illegible] a central projection; end vie[illegible]

Arthrodesmus octocornis. [illegible]

Frond smooth, minute, about [illegible] tion a wide notch; segment[illegible] much [illegible] each angle terminated by one or two [illegible] spines; the intervals between the [illegible] globose, armed with long simple [illegible]

SIZE. Diam. 16-25 μ (Wo[illegible]); [illegible] 16 μ [illegible]

Archer in Prit. Infus. (1861), pp. 73[illegible] Alg. Schles. (1878), p. 1[illegible] (C[illegible]) [illegible] 489. Lundell Desm. Suec. (1871), [illegible] Desm. (1873), p. 25. Wood F. W[illegible] p. 158. Brebisson Liste Desm. (1[illegible]) Eur. (1868), p. 225. Wolle Desm. U.S. (1[illegible]) 24, f. 19-23.

Euastrum octocorne, Kutz. Phy. Germ. (1845), p. 1[illegible]

Micrasterias octocornis, Meneg. Syn. Desm. (1840), p. 216.

Staurastrum ? octocorne, Ralfs. Ann. Nat. Hist. (1845) xv., p. 159, t. 12, f. 3.

Xanthidium octocorne, Ehr. Meterop., t. 1, f. 22. Ralfs. Desm. (1848), p. 116, t. 20, f. 2. Hassall Fr. Alg. (1845), p. 357.

Xanthidium octocorne, Jacobsen Desm. Denm. (1874), p. 211.

HAB. In ponds.

Sussex, Surrey, Hants, Gloucester, Westmoreland, Cornwall, Wales; France, Germany, Sweden, Norway, Denmark, Italy, United States.

Plate XLVII., fig. 2. *a c d*, living fronds; *b e*, empty fronds; *f*, side view; *g*, end view.

var. *a* **simplex.** *Ralfs. Desm.* (1848), *p.* 116.

Spines solitary at each angle.

HAB. In ponds, pools, &c.

Cornwall, Westmoreland; Sussex, Surrey, Hants, North Wales.

var. *β* **major.** *Ralfs. Desm.* (1848), *p.* 116.

Larger, spines geminate at each angle.

Rabh. Alg. Eur. (1868), p. 225. Nordstedt Norges Desm. (1873), p. 25.

HAB. In ponds.

North Wales.

Arthrodesmus incus. *Hass. F. W. Alg.* (1845), *p.* 357.

Frond minute, smooth, as long as or longer than broad, constriction a deep sinus; segments with inner margin turgid, outer truncate, spines subulate, acute, zygospore orbicular, spinuous, spines subulate.

SIZE. Diam. 10-36 μ (Wo.); length $22\frac{1}{2}$ μ; diam. 24 μ (K.); zygospore, without spines, 22 μ (K.).

Ralfs. Desm. (1848), p. 118, t. 20, f. 4. Archer in Prit. Inf. (1861), p. 737. Wolle Desm. U.S. (1884), p. 97, t. 24, f. 1-10. Cleve Sver. Desm. (1864), p. 489. Lundell Desm. Suec. (1871), p. 54. Nordstedt Norges Desm. (1873), p. 25. Wittrock Scan. Desm. (1869), p. 15. Breb. Liste Desm. (1856), p. 135. Wood F. Water Algæ U.S. (1872), p. 158. Rabh. Alg. Eur. (1868), p. 226. Kirchn. Alg. Schles. (1878), p. 156.

Cosmarium incus, Breb. in Meneg. Syn. Desm. (1840).

Staurastrum incus, Meneg. Syn. Desm. (1840), p. 228; Ralfs. Ann. Nat. Hist. (1845) xv., p. 158, t. 12, f. 2; Jabobsen Desm. Denm. (1874), p. 204.

Euastrum retusum, Kutz. Phy. Germ. (1845), p. 136.

Hab. In ponds and ditches.

Hants, Sussex, Essex, Gloucester, Westmoreland, Cornwall, Wales, Scotland; France, Germany, Sweden, Norway, Denmark, Italy, United States.

Plate XLVII., fig. 4. a c e f, living fronds; *b d g*, empty fronds; *h*, end view; *i*, zygospore.

var. *α*. **divergens.** *Archer Pritch. Infus.* (1861), *p.* 737.

Segments somewhat semi-orbicular, connected by a distinct neck, spines diverging.

Ralfs. Desm. (1848), p. 118, t. 20, f. 4 (exclus. *f.* and *g.*).

Hab. In ponds, &c.

var. *β*. **convergens.** *Archer Pritch. Infus.* (1861), *p.* 737, *t.* 3, *f.* 36.

Segments gibbous near the base; spines parallel or converging.

Ralfs. Desm. (1848), p. 118, t. 20, f. 4, *t. g.* Nordstedt Norges Desm. (1873), p. 25.

Hab. In ponds.

Arthrodesmus convergens. *Ehr. Inf.* (1838), *p.* 152, *t.* 10, *f.* 18.

Frond smooth, broader than long; constriction deep, acute; segments elliptic, each having its lateral spines curved towards those of the other; ends convex. Zygospore orbicular, smooth.

Size. Length 93 μ; diam. 58 μ (D.); diam. 38-40 μ (Wo.); length, 38-42 μ; diam. 40-46 μ. Zygospore 44 μ (K.).

Hassall Fr. Alg. (1845), p. 357. Ralfs. Desm. (1848), p. 118, t. 20, f. 3. Archer in Prit. Inf. (1861), p. 737. Cleve Sver. Desm. (1864), p. 489. Petit Liste Desm. Paris (1877), p. 32. Wittrock Scan. Desm. (1869), p. 15. Brebisson Liste Desm. (1856), p. 135. Rabh. Alg. Eur. (1868), p. 227. Wille Nov. Sem. (1879), p. 49. Lundell Desm. Suec. (1871), p. 54. Kirchn. Alg. Schles. (1878), p. 156. Nordstedt Norges Desm. (1873), p. 25. Wood F. Water Algæ U.S. (1872), p. 159. Wolle Desm. U.S. (1884), p. 95, t. 23, f. 19-21.

Xanthidium convergens, Delponte Desm. (1878), t. 14, f. 13-23.

Staurastrum convergens, Meneg. Syn. Desm. (1840), p. 2 Ralfs. Ann. Nat. Hist. (1845), xv., p. 158, t. 12, f. 1. Jaco sen Desm. Denm. (1874), p. 202.

Euastrum convergens, Kutz. Phy. Germ. (1845), p. 13 Näg. Ein. Alg. (1849), t. 7 c., f. 1.

Hab. In ponds.

Sussex, Kent, Herts, Gloucester, Cheshire, Westmorelan Lancashire, Yorkshire, Cornwall, Wales, Scotland, Ireland France, Germany, Sweden, Norway, Denmark, Nova Zembla Italy, United States.

Plate XLVII., fig. 1. *a c*, living fronds; *b*, empty frond; *d*, en view; *e*, zygospore.

Arthrodesmus bifidus. *Breb. Liste Desm.* (1856), *p.* 135.

Frond smooth, very minute, about as broad as long; segments somewhat arcuate, inner margin convex, outer concave, extremities divergent, emarginate, each angle terminating in an acute tooth; end view compressed, fusiform, with a short acute spine or tooth at each end.

Size. 18 μ with spines, 13 × 12 without spines (L.).

Archer in Prit. Inf. (1861), p. 736. Archer Micr. Journ. (1870), pp. 90. Lundell Desm. Suec. (1871), p. 55. Rabh. Alg. Eur. (1868), p. 226.

Hab. In pools.

Ireland; France, Sweden.

Plate XLVIII., fig. 2. *a c*, living fronds; *b d*, empty fronds; *e*, end views.

Arthrodesmus tenuissimus. *Archer Micr. Journ.* (1864), iv., *p.* 175, *t.* 6, *figs.* 50-55.

Frond extremely minute, segments sub-hexagonal, opposite lateral extremities acutely cuspidate, each upper angle furnished on each front with a minute acute mucro, of which four in the fusiform end view stand out divergently.

Size. Length 8½ μ; diam. 11 μ (A.).

Lundell Desm. Suec. (1871), p. 55. Rabh. Alg. Eur. (1868), p. 226.

Hab. Coating the moss in *Sphagnum* pools.

Ireland; Sweden.

Plate XLVII., fig. 3. *a*, living frond; *b*, empty frond; *d*, end view; *c*, empty frond further magnified; *e*, side view; *f*, end view.

GEN. 21. **STAURASTRUM.** *Meyen* (1829).

Frond more or less deeply constricted at the middle; segments broader than long, often provided with spines or processes, end view angular or radiate, or circular, with a lobed radiate margin, or very rarely compressed, with a process at each extremity.

I. Segments in front view, with each of the opposite lateral extremities furnished with a mucro, or a simple subulate acute awn, or spine, which in end view terminates the angles, and without others intermediate.

* *Segments smooth, angles in end view inflated, sides concave.*

Staurastrum dejectum. *Breb. in Meneg. Syn. Desm.* (1840), *p.* 227.

Segments smooth, lunate, or elliptic; constricted portion very short, awns projecting upwards; end view with three or four inflated awned lobes. Zygospore orbicular, spinous, spines at first hair-like, afterwards stout and subulate.

SIZE. 25 μ (W.); length 24-28 μ; diam. 19-33 μ (K.); diam. 25·38 μ; without spines (Wo.).

Ralfs. Desm. (1848), p. 121, t. 20, fig. 5. Archer in Prit. Infus. (1861), p. 737. Wittr. Sotv. Alg., p. 54. Cleve Sver. Desm. (1864), p. 489. Kirchn. Alg. Schles. (1878), p. 168. Lundell Desm. Suec. (1871), p. 59. Nordstedt Norges Desm. (1873), p. 27. Petit Liste Desm. Paris (1877), p. 31. Grunow Desm. Aust. (1858), p. 498. Wittrock Scan. Desm. (1869), p. 16. Wood F. Water Algæ U.S. (1872), p. 148. Wille Norges Desm., p. 40. Notaris Desm. Ital. (1867), p. 55, t. 5, f. 51. Rabh. Alg. Eur. (1868), p. 203. Jacobsen Desm. Denm. (1874), p. 203, in part. Schaarschm. Magy. Desm. (1883), p. 273. Brebisson Liste Desm. (1856), p. 142. Lemaire Desm. Vosg. (1883), p. 22. Nordst. Desm. Grönl. (1885), p. 10. Wolle Desm. U.S. (1884), p. 121, t. 40, f. 7-11, 17-21.

Staurastrum mucronatum, β., Ralfs. Ann. Nat. Hist. (1845), xv., t. 10, f. 5.

HAB. In ponds.

Surrey, Sussex, Kent, Hants, Cornwall, Norfolk, Gloucester, Westmoreland, Lancashire, Wales, Ireland, Scotland; France, Germany, Sweden, Denmark, Norway, Austria, Hungary, Italy, Greenland, United States.

Plate XLIX., fig. 1. *a*, living frond; *b*, empty frond; *c*, variety; *d e f*, end views; *g*, zygospore.

var. *a.* **lunatum.** *Ralfs. Desm.* (1848), *p.* 121.

Segments externally lunate, awns directed outwards.

Archer in Prit. Inf. (1861), p. 737.

var. *β.* **directum.** *Ralfs. Desm.* (1848), *p.* 121.

Segments elliptic, awns parallel.

Archer in Prit. Inf. (1861), p. 737.

var. *γ.* **mucronatum.** *Ralfs. Desm.* (1848), *p.* 121.

Awns converging.

SIZE. Length 27 μ; diam. 30 μ (N.).

Goniocystis (Trigonocystis) mucronata, Hass. Fr. Alg. (1845), p. 350.

Staurastrum dejectum, var γ, Rabh. Alg. Eur. (1868), p. 203. Wolle Desm. U.S. (1884), p. 121, t. 40, f. 8. Archer in Prit. Inf. (1861), p. 737.

Staurastrum mucronatum, α and γ, Ralfs. Ann. Nat. Hist. (1845), xv., t. 10, f. 5.

Staurastrum mucronatum, Lundell Desm. Suec. (1871), p. 59. Nordstedt Norges Desm. (1873), p. 27. Lemaire Desm. Vosg. (1883), p. 22. Petit Liste Desm. Paris (1877), p. 31. Brebisson Liste Desm. (1856), p. 142. Nordst. Desm. Spitz. (1872), p. 38.

Plate LV., fig. 7. *a,* living fronds; *b,* empty fronds; *c d,* end views.

Staurastrum apiculatum. *Breb. List. Desm.* (1856), *p.* 142.

Segments in front view somewhat turbinate, smooth [illegible] lateral extremities round [illegible] at each side, on the upper outer margin, near the lateral extremities, with a simple short, subulate, acute spine directed upwards; end view with three angles, angles inflated, mammillate, terminated by a short acute spine, sides concave. Zygospore orbicular, beset with conical spines, enlarged at the base, and obtuse at the apex.

SIZE. Length and diam. 18 μ (L.).

Archer Micr. Journ. (1868), p. 65. Archer Prit. Inf. (1861), p. 737.

Staurastrum dejectum var. *β apiculatum.* Lundell Desm. Suec. (1871), p. 59. Wittr. Sotv. Alg. (1872), p. 54. Nordstedt Norges Desm. (1873), p. 27. Kirchn. Alg. Schles. (1878), p. 168. Wille Norges Desm., p. 40.

HAB. In ponds.

Cornwall, Ireland; France, Germany, Sweden, Norway.

Plate XLIX., fig. 2. *a,* living fronds; *b,* empty fronds; *c d,* end views.

Staurastrum Dickiæi. *Ralfs. Desm.* (1848), *p.* 123, *t.* 21, *f.* 3.

Segments in front view subelliptic, turgid, smooth; spines short, curved, acute, converging with those of the opposite segment; end view with three angles; angles inflated, rounded, terminated by a spine; sides concave at the centre.

SIZE. Diam. 36-44 μ (Wo.).

Archer in Prit. Inf. (1861), p. 737. Cleve Sver. Desm. (1864), p. 489. Lundell Desm. Suec. (1871), p. 66. Nordstedt Norges Desm. (1873), p. 27. Petit Liste Desm. Paris (1877), p. 31. Brebisson Liste Desm. (1856), p. 142. Wille Nov. Sem. (1879), p. 52. Wille Norges Desm. (1880), p. 41. Schaarschm. Magy. Desm. (1883), p. 272. Lemaire Desm. Vosg. (1883), p. 22. Wolle Desm. U.S. (1884), p. 122, t. 40, f. 5, 6; t. 51, f. 20, 21.

Staurastrum dejectum β Dickiei, Jacobsen Desm. Denm. (1874), p. 204.

Staurastrum brevispina var. b. *Dickiei,* Rabh. Alg. Eur. (1868), p. 202.

HAB. In pools.

Lake District, Cornwall, Wales, Scotland; France, Germany, Sweden, Norway, Denmark, Hungary, Nova Zembla, United States.

Plate XLIX., fig. 3. *a*, living frond; *b*, empty frond; *c d*, end views.

Staurastrum brevispina. *Breb. in Meneg. Syn. Desm.* (1840), *p.* 229.

Segments in front view elliptic, or somewhat reniform, very turgid, smooth; mucrones minute, inconspicuous; end view with three angles; angles inflated, broadly rounded, terminated by an inconspicuous mucro; sides concave at the centre.

SIZE. Diam. 40 μ (K.); diam. 45-48 μ (Wo.).

Ralfs. Desm. (1848), p. 124, t. 34, f. 7. Archer in Prit. Inf. (1861), p. 737. Cleve Sver. Desm. (1864), p. 489. Lundell Desm. Suec. (1871), p. 59. Brebisson Liste Desm. (1856), p. 143. Rabh. Alg. Eur. (1868), p. 202 (sine var. b). Wille Nov. Sem. (1879), p. 52. Kirchn. Alg. Schles. (1878), p. 168. Schaarschm. Magy. Desm. (1883), p. 272. Lemaire Desm. Vosg. (1883), p. 22. Wolle Desm. U.S. (1884), p. 121, t. 40, f. 1, 2; t. 53, f. 2, 3.

Staurastrum muticum var. *brevispina,* Jacobsen Desm. Denm. (1874), p. 202.

HAB. In pools.

Sussex, Cornwall; France, Germany, Sweden, Nova Zembla, Denmark, Hungary, United States.

Plate XLIX., fig. 4. *a*, living frond; *b*, empty fronds; *c d*, variety of same; *e f*, end views.

Staurastrum cuspidatum. *Breb. in Meneg. Syn. Desm.* (1840), *p.* 226.

Segments smooth, fusiform, connected by a long narrow band; awns parallel or converging, but straight; end view with inflated awned lobes. Zygospore orbicular, spinous; spines ultimately attenuated and acute.

SIZE. Length 25-30 μ; diam. 25 μ (K.); length 25 μ; diam. 21 μ (D.); length 30 μ; diam. 25 μ (Wo.).

Ralfs. Desm. (1848), p. 124, t. 21, f. 1; t. 33, f. 10. Archer in Prit. Inf. (1861), p. 737, t. 1, f. 31-34. Delponte Desm. (1878), t. 10, f. 16-33; Cleve Sver. Desm. (1864), p. 489. Wittr. Sotr. Alg. 54. Lundell Desm. Suec. (1871), p. 60. Kirchn. Alg. Schles. (1878), p. 169. Nordstedt. Norges Desm. (1873), p. 28. Petit Liste Desm. Paris (1877), p. 31. Nordst. & Wittr. Desm. Ital. (1876), p. 42. Brebisson Liste Desm. (1856), p. 142. Rabh. Alg. Eur. (1868), p. 203. Wolle Desm. U.S. (1884), p. 123, t. 40, f. 23-25. Wille Norges Desm. (1880), p. 41. Schaarschm. Magy. Desm. (1883), p. 272. Lemaire Desm. Vosg. (1883), p. 23. Nordst. Desm. Bras. (1869), p. 225.

Phycastrum cuspidatum, Kutz. Phy. Germ. (1845), p. 138.

Phycastrum spinulosum, Näg. Einz. Alg. (1849), t. 8 A., f. 2.

Binatella cuspidatum, Breb. Alg. Fal. (1835), p. 57, t. 8.

Staurastrum cuspidatum, var. *Ralfsiana*, Jacobsen Desm. Denm. (1874), p. 203.

HAB. In ponds.

Lancashire, Hants, Cornwall, Essex, Wales; France, Germany, Sweden, Norway, Denmark, Hungary, Italy, Brazil, United States.

Plate XLIX., fig 5. *a*, living fronds; *b*, empty fronds; *c d*, end views; *e*, zygospore.

Staurastrum aristiferum. *Ralfs. Desm.* (1848), *p.* 123, *t.* 21, *f.* 2.

Segments smooth, the lobes in front view prolonged into mammillate awned projections, which are somewhat constricted at the base; end view with three or four awned lobes; sides deeply concave at the centre.

SIZE. Diam. with spines 36 μ (K.); diam. 15-20 μ without spines (Wo.).

Archer in Prit. Inf. (1861), p. 737. Lundell Desm Suec. (1871), p. 61. Nordstedt Norges Desm. (1873), p. 28. Petit Liste Desm. Paris (1877), p. 31. Wood F. Water Algæ U.S. (1872), p. 149. Brebisson Liste Desm. (1856), p. 142. Rabh. Alg. Eur. (1868), p. 204. Nordst. Desm. Bras. (1869), p. 226. Wolle Desm. U.S. (1884), p. 122, t. 40, f. 15, 16. Kirchn. Alg. Schles. (1878), p. 169.

HAB. In ponds.

Wales; France, Germany, Sweden, Norway, Brazil, United States.

Plate XLIX., fig. 6. *a*, living frond; *b*, empty frond; *c d*, variety; *e f*, end views.

Staurastrum megacanthum. *Lundell Desm. Suec.* (1871), *p.* 61, *t.* IV., *f.* 1.

Of medium size, nearly as long as broad, very deeply constricted, sinus acute-angled or rectangular; semi-cells triangular-fusiform and ventricose; dorsal margin sub-truncate or slightly convex, attenuated on each side into a stout spine; end view three or four-sided; sides concave, angles produced into a firm spine; membrane delicately punctate.

SIZE. Triangular form, 50 × 57 μ; quadrangular form, 46 × 61 μ (L.).

Nordst. Norges Desm. (1873), p. 28. Wolle Desm. U.S. (1884), p. 121, t. 51, f. 10-12.

HAB. In pools.

Sweden, Norway, United States.

Plate XLIX., fig. 7. *a*, living frond; *b*, empty frond; *c*, variety; *d*, end view.

*** Segments smooth, angles in end view not inflated, sides straight.*

Staurastrum O'Mearii. *Archer in Nat. Hist. Rev.* (1858), *p.* 254, *t.* 21, *f.* 8-13.

Frond very minute; segments smooth, ends truncate (or slightly convex; central constriction in front view somewhat cuneiform, gradually widening upwards; outer margin truncate, awns acute, divergent; end view with three or four acute angles terminated by an awn, sides straight. Zygospore orbicular, spinous, spines subulate, acute, ultimately somewhat inflated at the base.

SIZE. 13 × 10 μ (A.).

Archer in Prit. Inf. (1861), p. 738. Nordstedt Norges Desm. (1873), p. 27. Rabh. Alg. Eur. (1868), p. 204.

HAB. In pools.

Ireland, Norway.

var. β. End view with three angles, awns longer.

SIZE. 14 × 11 μ (A.)

HAB. In pools.

Ireland.

Plate L., fig. 1. *a a*, living fronds; *b b*, empty fronds; *c d e f*, end views; *g*, zygospore.

Staurastrum pterosporum. *Lundell. Desm. Suec.* (1871), *p.* 60, *t.* III., *f.* 29.

Small, about as long as broad, median incision deep, very broad; semi-cells somewhat wedge-shaped, dilated upwards, dorsal margin truncate, sides straight, angles rather acute, furnished with a very delicate spine; end view triangular, sides straight, angles somewhat acute, delicately cuspidate. Zygospore rectangular, compressed, the angles produced into a broad lobe, which resembles the remains of the empty semi-cell.

SIZE. 14-15 μ; zygospore 20 × 13 μ (L.).

HAB. In pools.

Westmoreland; Sweden.

Plate L., fig. 2. *a,* living frond; *b,* empty frond; *c d e,* end views; *f,* zygospore.

Staurastrum lævispinum. *Bisset. Journ. Roy. Micr. Soc.* (1884), IV., *p.* 195, *t.* 5, *f.* 5.

Frond small. Semi-cells in front view sub-triangular, produced laterally into a somewhat thick, obtuse, hyaline arm, upper margin concave, sides nearly straight, end view triangular, sides concave, ends obtuse, colourless; membrane smooth.

SIZE. Length 28-30 μ; diam. 32-35 μ; breadth of constriction 9 μ (B.).

HAB. Mountain pools.

Lake District (England); Arran (Scotland).

Plate L., fig. 3. *a,* living frond; *b,* empty frond; *c d,* end views.

Staurastrum glabrum. *(Kutz.) Ralfs. Desm.* (1848), *p.* 217.

Segments smooth, in front view cuneate, ends concave or straight; spines slender, mucro-like; end view with three mucronate angles, sides concave.

SIZE. About 35 μ × 26 μ.

Archer in Prit. Inf. (1861), p. 738.

Desmidium glabrum, Ehr. Mikr. Leb. S. & N.A. (1843), Meteorp., t. 1, f. 13.

Phycastrum glabrum, Kutz. Phy. Germ. (1845), p. 137.

Staurastrum dejectum, Rabh. Alg. Eur. (1868), p. 203, in part.

HAB. In pools.

Cornwall, Ireland; Germany.

Plate L., fig. 4. *a b c,* end views.

⁂ *Segments rough with minute granules.*

Staurastrum lunatum. *Ralfs. Desm.* (1848), *p.* 124, *t.* 34, *f.* 12.

Frond rough with puncta-like granules; segments externally lunate, with an awn at each angle; spines subulate, acute, curved, obliquely directed outwards and upwards; end view with three inflated awned lobes; sides concave at the centre.

SIZE. About 30 × 25 μ.

Archer in Prit. Inf. (1861), p. 738. Nordstedt Norges Desm. (1873), p. 28. Rabh. Alg. Eur. (1868), p. 221.

HAB. In pools.

Cornwall, Norway.

Plate L., fig. 5. *a*, living frond; *b*, empty frond; *c c d*, end views.

II. Segments in front view with each of the opposite lateral extremities furnished with a mucro or simple subulate spine, which in end view terminates the angles, and is accompanied by others intermediate of a similar character.

Staurastrum pungens. *Bréb. in Ralfs. Desm.* (1848), *p.* 130, *t.* 34, *f.* 10.

Frond smooth, each end with about six subulate spines, directed outwards; each angle in the end view tapering into a spine which has two smaller ones at the base; segments in front view externally lunate, the inner margin curved, the outer truncate.

SIZE. Length and diam. 26 μ (L.).

Archer in Prit. Inf. (1861), p. 738. Lundell Desm. Suec. (1871), p. 64. Nordstedt Norges Desm. (1873), p. 31. Petit Liste Desm. Paris (1877), p. 31. Brebisson Liste Desm. (1856), p. 137. Rabh. Alg. Eur. (1868), p. 214. Jacobsen Desm. Denm. (1874), p. 209. Schaarschm. Magy. Desm. (1883), p. 273.

HAB. In ponds.

Sussex, Cornwall; France, Sweden, Norway, Denmark, Hungary, United States.

Plate L., fig. 6. *a*, living frond; *b*, empty frond; *c c d*, end views.

Staurastrum cristatum. *Näg. Einz. Alg.* (1849), *p.* 127, *t.* 8, *f. c.* 1.

Frond rough at the ends with a series of papilla-like granules; segments broadly elliptic, inner margin somewhat more turgid than the outer; end view triangular; sides convex, with a submarginal series of papillæ; angles not inflated, mucronate.

SIZE. Length 40 μ; diam. 40 μ (N.).

Archer in Prit. Inf. (1861), p. 738. Micr. Journ. (1866), p. 189. Cleve Sver. Desm. (1864), p. 490. Lundell Desm. Suec. (1871), p. 64. Nordstedt Norges Desm. (1873), p. 31. Rabh. Alg. Eur. (1868), p. 215. Nordstedt Desm. Spitz.

(1872), p. 12. Jacobsen Desm. Denm. (1874), p. 208. Wille Norges Desm. (1880), p. 44. Lemaire Desm. Vosg. (1883), p. 23.

Phycastrum (Pachyactinium) cristatum, Näg. Einz. Alg. (1849), p. 127, t. 8, f.c. 1.

Staurastrum nitidum, Archer. Nat. Hist. Rev. (1859), p. 463, t. 33, f. 3, 4.

HAB. In ponds, &c.

Cornwall; France, Germany, Sweden, Norway, Denmark, Spitzbergen.

Plate L., fig. 7. *a c*, living fronds; *b*, empty frond; *d e*, end views.

Staurastrum oligocanthum. *Breb. in litt.*

Similar in size and habit to *S. cristatum.*

In front view the ends are flat, the lateral extremities subacute. In end view the sides concave at the middle, angles inflated, then acute.

SIZE. Length and diam. 40 μ (N.).

Archer Micr. Journ. (1866), vi., n.s., pp. 67 and 189. Nordstedt Norges Desm. (1873), p. 31. Nordstedt Desm. Arct. (1875), p. 36. Wille Norges Desm. (1880), p. 44.

HAB. In pools.

Ireland, France, Norway, Spitzbergen.

Plate L., fig. 8. *a*, living frond; *b*, empty frond; *c*, end view; *d*, semi-cell further magnified.

III. Segments with each of the opposite lateral extremities furnished with a bifid or forked spine, its sub-divisions subulate, acute, in end view terminating the angles and appearing as a mucro-like spine with or without intermediate spines.

Staurastrum avicula. *Breb. in Ralfs Desm.* (1848), *p.* 140, *t.* 23, *f.* 11.

Segments in front view triangular or cuneate, with a forked spine on each side; each angle, in end view, terminated by a mucro-like spine, with three inflated angles, the bifid spine appearing as a mucro ; sides concave.

SIZE. Length 43 μ; diam. 50 μ (D.); diam., without spines, 25-30 μ (W).

Wille Norges Desm. (1880), p. 41. Archer in Prit. Inf. (1861), p. 738, t. 3, f. 18-19. Delponte Desm. (1878), t. xii., f. 22-29. Lundell Desm. Suec. (1871), p. 61. Nordstedt Norges Desm. (1873), p. 28. Brebisson Liste Desm. (1856),

p. 137. Rabh. Alg. Eur. (1868), p. 204. Schaarschm. Magy. Desm. (1883), p. 272. Lemaire Desm. Vosg. (1883), p. 23. Nordst. Desm. Bras. (1869), p. 226. Kirchn. Alg. Schles. (1878), p. 170. Wolle Desm. U.S. (1884), p. 123, t. 40, f. 30-32.

HAB. In ponds, &c.

Cornwall, Lake District; France, Sweden, Norway, Italy, Hungary, Brazil, United States.

Plate L., fig. 9. *a*, living frond; *b*, empty frond; *c d*, end view; *e*, pair of fronds.

Staurastrum furcatum. (*Ehr.*) *Pritch. Infus.* (1861), *p.* 743.

Segments smooth, in front view broadly elliptic, furnished at each opposite lateral extremity with a colourless bifid process, and with six others similar and divergent on external margin (four only of which are usually visible); end view with three acute angles, each tapering into a terminal process, and each bearing two others on the upper surface, placed to each side, and projecting laterally. Zygospore orbicular, armed with bifid spines.

SIZE. Length 30 μ; diam. 37-40 μ (K.).

Breb. Liste Desm. (1856), p. 136. Rabh. Alg. Eur. (1868), p. 218, in part. Lundell Desm. Suec. (1871), p. 66. Nordst. Norges Desm. (1873), p. 33. Jacobsen Desm. Denm. (1874), p. 209. Schaarschm. Magy. Desm. (1882), p. 295. Kirchn. Alg. Schles. (1878), p. 170.

Xanthidium furcatum, Ehr. Abh. (1833), p. 318.

Asteroxanthium furcatum, Kutz. Sp. Alg. (1849), p. 182.

HAB. In ponds, &c.

France, Germany, Sweden, Norway, Denmark, Hungary.

var. **armigerum.** *Breb. in Pritch. Infus.* (1861), *p.* 738.

Segments furnished with a few bifid spines, lateral spines solitary, larger and more forked; end view triangular, with two or three spines on each side and one terminating each angle.

SIZE. 35 × 35 μ.

Petit Liste Desm. Par. (1877), p. 31.

Staurastrum spinosum, Ralfs. Desm. (1848), p. 143, t. 22, f. 8. Mask. N. Zeal. Desm. (1882), p. 244.

Staurastrum furcatum, form *e.f.*, Rabh. Alg. Eur. (1868), p. 218.

HAB. In ponds, &c.

Surrey, Westmoreland, Cornwall, Wales; France, New Zealand.

Plate LI., fig. 1. *a a,* living fronds; *b,* empty frond; *c c,* end views; *d,* zygospore.

var. **candianum.** *Delponte Desm. Ital.* (1878).

SIZE. About 48 × 40 μ.

Staurastrum candianum, Delponte, *loc. cit.*

HAB. In pools.

North Wales, Italy.

Plate LIII., fig. 6. *a,* living frond; *b,* empty frond; *c d,* end views.

Staurastrum pseudo-furcigerum. *Reinsch. Alg. Fl.* (1867), *p.* 169, *t.* 11, *fig.* 2.

Frond smooth, semi-cells broadly elliptic, sides produced into a short stout process, with margins smooth and apices bifurcate; end view triangular, one process at each angle, and two near the margin of each side, extending beyond it, making nine processes to each semi-cell.

SIZE. Diam 37-40 μ (Wo.); length, without spines, 42-46 μ; diam. 38-43 μ; spines 13-15 μ long (R.); length, without spines, 37-55 μ; diam. 34-48 μ (L.).

Wolle Desm. U.S. (1884), p. 147, t. 52, f. 27-28. Lundell Desm. Suec. (1871), p. 71. Nordst. Norges Desm. (1873), p. 36. Wittr. Sottv. Alg. (1872), p. 50. Wille Norges Fers. (1880), p. 46.

Staurastrum furcatum c. pseudo-furcigerum, Rabh. Alg. Eur. (1868), p. 218.

HAB. In ponds and pools.

North Wales; Germany, Norway, Sweden, United States.

Plate LXI., fig. 4. *a a,* living fronds; *b b,* empty fronds; *c d,* end views.

Staurastrum monticulosum. *Breb. in Meneg. Syn. Desm.* (1840), *p.* 226.

Segments in front view broadly elliptic, smooth, with a forked spine on each side, and at the end about four short, acute projections; end view acutely triangular, with a bifid appendage to each angle, sides concave.

SIZE. Length 34 μ; diam. 37 μ; with spines 43 μ (L.); length 33-35 μ; diam. 38 μ (Wo.).

Archer in Prit. Inf. (1861), p. 738. Nat. Hist. Rev. (1858).

Wille Norges Desm. (1880), p. 43. Cleve Sver. Desm. (1864), 490. Lundell Desm. Suec. (1871), p. 65. Nordstedt Norges Desm. (1873), p. 31. Brebisson Liste Desm. (1856), p. 138. Rabh. Alg. Eur. (1868), p. 214. Jacobsen Desm. Denm. (1874), p. 209. Schaarschm. Magy. Desm. (1883), p. 273. Wolle Desm. U.S. (1884), p. 144, t. 51, f. 24-26 var.

Stephanoxanthium monticulosum, Kutz. Spec. Alg. (1849), 184.

Phycastrum monticulosum, Kutz. Phy. Germ. (1845), p. 138.

Staurastrum monticulosum, Ralfs Desm. (1848), p. 130, t. 34, f. 9.

HAB. In pools.

Cornwall, Lake District; France, Germany, Sweden, Norway, Denmark, Hungary.

Plate L., fig. 10. *a*, living frond; *b*, empty frond; *c d e*, end views.

Staurastrum sub-cruciatum. *Cooke & Wills, MSS.*

Rather small, about as broad as long, or a little broader, constriction rectangular, expanding, segments obversely triangular, angles produced into a short furcate spine, either plane or a little directed upwards, dorsal margin slightly convex or nearly straight, granulate, lateral margins also very slightly convex and granulate, surface granulate, granules at the angles in transverse lines, end view triradiate, angles ending in a short spine, sides very slightly concave.

SIZE. Length 30 μ ; diam., with spines, 35 μ.

HAB. In mountain pools.

Capel Curig. (N. Wales).

Plate LI., fig. 3. *a*, living frond; *b*, empty frond; *c d*, end views.

Staurastrum Reinschii. *Roy Journ. Roy. Micr. Soc., p.* 196.

Semi-cells in front view broadly ovate-cordate, apex broadly rounded, lateral extremities truncate auriculate, armed with two short spines, incision acute-angled, end view triangular, sides somewhat convex, angles rounded, armed with a single spine, cell membrane furnished with bicuspidate and entire spines, disposed irregularly.

SIZE. Length and diam. 20 μ (Re.).

Staurastrum sp., Reinsch. Contrib. (1874), p. 86, t. xvii, f. 5.

HAB. In mountain pools.

Lake District (England); Germany.

Plate LI., fig. 4. *a*, living frond; *b*, empty frond; *c*, same further magnified (after Reinsch.); *d e*, end views; *f g*, end views of variety.

Staurastrum tuberculatum. *Bennett Journ. Roy. Micr. Soc.,* (1886), *p.* 12, *fig.* 24.

Frond moderately large, semi-cells nearly hexagonal in shape, terminal and upper lateral edges nearly straight or slightly convex, lower lateral edges concave, the whole margin, except the lower lateral edges, rough with pearly granules, which are larger at the corners. Surface of frond tuberculate.

Size. Length 70 μ ; diam. 55 μ (B.).

Hab. In bog pools.

Lake District (England).

Plate LX., fig. 6. *a,* living frond ; *b,* empty frond after Bennett.

IV. Segments with numerous simple acute spines, in front view no one in particular terminating the opposite lateral extremities, end view angles entire, rounded, the spines scattered.

Staurastrum hirsutum. *Breb. in Ralfs Desm.* (1848), *p.* 127, *t.* 22, *f.* 3.

Segments semi-orbicular, rough with numerous hair-like spines ; end view with three rounded angles, and straight or slightly convex sides. Zygospore orbicular, beset with short, branched spines.

Size. Diam. 40-62 μ (K.) ; diam. 40-60 μ (Wo.) ; length 46 μ; diam. 36 μ (D.).

Wille Norges Desm. (1880), p. 43. Archer in Pritch. Inf. (1861), p. 739. Delponte Desm. (1878), t. 11, f. 31-32. Notaris Desm. Ital. (1867), t. 4, f. 41. Cleve Sver. Desm. (1864), p. 490. Lundell Desm. Suec. (1871), p. 63. Nordstedt Norges Desm. (1873), p. 30. Wood F. Water Algæ U.S. (1872), p. 152. Brebisson Liste Desm. (1856), p. 141. Notaris Desm. Ital. (1867), p. 50, t. 4, f. 41. Rabh. Alg. Eur. (1868), p. 211. Jacobsen Desm. Denm. (1874), p. 205. Schaarschm. Magy. Desm. (1883), p. 273. Lemaire Desm. Vosg. (1883), p. 23. Wolle Desm. U.S. (1884), p. 141, t. 45, f. 19-21. Kirchn. Alg. Schles. (1878), p. 166.

Binatella hispida, Breb. Alg. Fal. (1835), p. 58, t. 8.

Euastrum (Xanthidium) hirsutum, Kutz. Phy. Germ. (1845), p. 137.

Xanthidium hirsutum, Ehr. Abh. Berl. Ak. (1833), p. 318 ; Ehr. Inf. (1838), p. 147, t. 10, f. 22.

Goniocystis (Trigonocystis) muricata, Hass. Fr. Alg. (1845), p. 351.

Staurastrum muricatum, Ralfs Ann. Nat. Hist (1845), xv, t. 11, f. 1, *a*, *b*, *c*.

HAB. In ponds.

Sussex, Lancashire, West Yorkshire, Westmoreland, Cornwall, Wales, Scotland; France, Germany, Sweden, Norway, Denmark, Italy, Hungary, United States.

Plate LII., fig. 1. *a*, living frond; *b*, empty frond; *c d e*, end views; *f g*, zygospores.

Staurastrum pilosum. *Näg. Einz. Alg.*, *t.* 8 *a*, *f.* 4.

Segments in front view obliquely elliptic, slightly divergent, the outer margin more turgid than the inner, end view with three rounded angles, sides concave, scattered all over, except a small space at the centre, with extremely fine hair-like spines, minutely capitate at their extremities, surface between the spines smooth.

SIZE. Length 44 μ; diam. 38 μ (N.); length 50 μ; diam. 42 μ.

Archer in Prit. Inf. (1861), p. 739. Nordst. Norges Desm. (1873), p. 30. Nordst. Desm. Arct. (1873), p. 34.

HAB. In pools, &c.

England, West Yorkshire; Germany, Norway, Spitzbergen.

Plate LII., fig. 5. *a*, living frond; *b*, empty frond; *c d*, end views; *e*, zygospore.

Staurastrum Brebissonii. *Archer in Pritch. Infus.* (1861), *p.* 739.

Segments in front view ovate-lanceolate, lateral extremities rounded, and furnished with numerous short, close-set, hair-like spines, otherwise smooth, end view with three broadly rounded angles, the spines confined to the extremities, sides concave. Zygospore globose, clad with processes once or twice divided at the apex.

SIZE. Length 60 μ; diam. 54 μ (W.); length 48 μ; diam. 43-50 μ (N.); length 72 μ; diam. 62 μ; zygospore 72 μ.

Lundell Desm. Suec. (1871), p. 63. Nordstedt Norges Desm. (1873), p. 30. Nordstedt Desm. Arct. (1875), p. 39. Wille Nov. Sem. (1879), p. 34. Wittr. Sotv. Alg. p. 53. Nordst. Desm. Spitz. (1872), p. 39. Jacobsen Desm. Denm. (1874), p. 206. Wille Norges Desm. (1880), p. 43. Schaarschm. Magy. Desm. (1883), p 273. Lemaire Desm. Vosg. (1883), p. 23. Nordstedt Desm. Grön. (1885), p. 10. Wolle Desm., U.S. (1884), p. 141, t. 45, f. 5, 6.

Staurastrum pilosum, Breb. Liste Desm. (1856), 141, pl. 2, f. 49. Cleve Sver. Desm. (1864), 490, t. 4, f. 3.

Staurastrum pilosum, var. *Brebissonii*, Rabh. Alg. Eur. (1868), p. 212.

Hab. In pools, &c.

Ireland, Lake District; France, Sweden, Norway, Denmark, Greenland, Nova Zembla, Spitzbergen, Hungary, United States.

Plate LII., fig. 6. *a*, living frond; *b*, empty frond; *c d*, end views.

Staurastrum teliferum. *Ralfs Desm.* (1848), *p.* 128, *t.* 22, *f.* 4; *t.* 34, *f.* 14.

Segments reniform, bristly; end view triangular, with concave sides, and broadly rounded bristly angles. Zygospore orbicular, beset with spines, which are bifid at the tips.

Size. Length 46 μ; diam. 43 μ (D.); diam. 36-50 μ (K.).

Archer in Prit. Inf. (1861), p. 739, t. 3, f. 20, 21. Delponte Desm. (1878), t. 11, f. 1-4. Notaris Desm. Ital. (1867), t. 4, f. 40. Cleve Sver. Desm. (1864), p. 490. Lundell Desm. Suec. (1871), p. 64. Nordstedt Norges Desm. (1873), p. 30. Petit Liste Desm. Paris (1877), p. 31. Wittrock Scan. Desm. (1869), p. 18. Brebisson Liste Desm. (1856), p. 141. Notaris Desm. Ital. (1867), p. 50, t. 4, f. 40. Rabh. Alg. Eur. (1868), p. 212. Wille Norges Desm. (1880), p. 43.
maire Desm. Vosg. (1883), p. 23. Wolle Desm. U.S. (
p. 140, t. 45, f. 4. Kirchner Alg. Schles. (1878), p.
Jacobsen Desm. Denm. (1874), p. 205.

Hab. In moor pools. West Yorkshire.

Sussex, Westmoreland, West Yorkshire, Cornwall, Wales; France, Germany, Sweden, Denmark, Norway, Italy.

var. β. **convexum,** *Benn. Journ. Roy. Micr. Soc.* (1886), *p.* 11, *figs.* 21-23.

Sides slightly convex.

Lake District.

Plate LII., fig. 2. *a*, living frond; *b*, empty frond; *c d*, end views; *e*, zygospore.

Staurastrum hystrix. *Ralfs Desm.* (1848), *p.* 128, *t.* 22, *f.* 5.

Segments subquadrate, spinous; end view with three or four rounded angles, each furnished with a few subulate spines.

Size. Diam. 22-25 μ (Wo.); length 24 μ; diam. 22 μ.

Archer in Prit. Inf. (1861), p. 739. Cleve Sver. Desm. (1864), p. 490. Lundell Desm. Suec. (1871), p. 64. Nordstedt Norges Desm. (1873), p. 31. Wood F. Water Algæ U.S. (1872), p. 154. Rabh. Alg. Eur. (1868), p. 213.

Schaarschm. Magy. Desm. (1883), p. 273. Lemaire Desm. Vosg. (1883), p. 23. Wolle Desm. U.S. (1884), p. 142, t. 45, f. 14-16.

Hab. In ponds and pools.

Sussex, Wales; France, Sweden, Norway, Hungary, United States.

Plate LII., fig. 3. *a,* living frond; *b,* empty frond; *c d e,* end views.

Staurastrum Pringsheimii. *Reinsch. Alg. Fl.* (1867), 172.

Segments in front view elliptical, with a rectangular incision at the point of union; end view triangular with nearly straight sides and rounded end. Cell membranes covered more or less densely with firm truncate spines.

Size. Length 65-69 μ; diam. 61-64 μ (Re.).

Hab. In mountain pools.

Lake District, North Wales; Germany.

Plate LII., fig. 4. *a,* living frond; *b,* empty frond; *c d,* end views.

Staurastrum Royanum. *Archer Micr. Journ.* XVII. (1877), *p.* 103.

Somewhat resembling *S. Pringsheimii,* but usually with the addition of two, sometimes four or five long, stout, subulate spines at each angle; the spines on the surface are less numerous and definite. Across the broadly elliptico-fusiform semicell, on each front surface, near the base, runs a series of four spines, a marginal series of five above this on the upper surface. In end view are fifteen spines, two—one behind the other—obliquely pointing towards each of the three angles, and a series of three on each side between each of the innermost of the pairs, at the angles. When the angles bear two or three of the long and rather stout spines, they are usually superimposed, and one only presents itself to view in the end view, though occasionally divergent; when there are more than three angular spines they seem to form an obliquely radiating group.

Size. Not stated.

Hab. In bog pools.

Ireland, Scotland.

Staurastrum bullosum. *Bennett Roy. Micr. Journ.* VI. (1886), *p.* 11, *fig.* 18-20.

Frond moderately large, semi-cells elliptical, more than twice as long as broad, triangular in end view, united by a narrow isthmus. Each segment with a hemispherical projection, which is very conspicuous, especially in end view. Frond and projection uniformly verrucose, fringed with colourless, equidistant, subulate spines.

SIZE. Length 85 μ; diam. 38 μ (B.).

HAB. Amongst moss in streams.

Lake District (England).

Plate LI., fig 5. *a*, living frond; *b*, empty frond; *c d*, end views (after Bennett).

Staurastrum acarides. *Nordst. Desm. Spetz.* (1872), *p.* 40, *t.* 7, *f.* 26.

Medium size, about one-half longer than broad, elliptical oblong, apex sub-truncate or retuse, constricted in the middle, with a narrow linear sinus; semi-cells somewhat semi-circular, with the apex retuse, inferior angles rectangular, superior angles broadly rounded a little above the middle, with a semi-elliptic incision on each side, about the margin, and within it, furnished with small prominent spines; end view triangular, sides retuse, angles rounded, obtuse.

SIZE. Length 40-45 μ; diam. 30-33 μ (N.).

Nordst. Norges Desm. (1873), p. 32. Wille Nova Sem. (1879), p. 54. Nordst. Desm. Arct. (1873), p. 37.

HAB. In pools.

Stirling, N.B.; Norway, Nova Zembla, Spitzbergen.

Plate LX., fig. 5. *a*, living frond; *b*, empty frond; *c d e*, end views.

V. Segments with numerous short truncate emarginate scattered spines, principally confined to the margins, end view angles rounded; if angles spinous, no spine in particular conspicuously larger than the others terminating the angles.

Staurastrum spongiosum. *Breb. in Meneg. Syn. Desm.* (1840), *p.* 229.

Segments semi-orbicular, spinulose; spines forked; end view triangular, bordered with forked spines; angles rounded. Zygospore globose, with numerous spines once or twice forked at the tips.

SIZE. Diam. 45-50 μ (K.); diam. 45-50 μ (Wo.); zygospore 56 μ without spines (L.).

Ralfs Desm. (1848), p. 141, t. 23, f. 4. Archer in Prit. Inf. (1861), p. 739, t. 3, f. 22-23. Nordstedt Desm. Arct. (1875), p. 37. Wille Norges Desm., p. 43. Cleve. Sver. Desm. (1864), p. 490. Kirchn. Alg. Schles. (1878), p. 166.

Lundell Desm. Suec. (1871), p. 65. Nordstedt Norges. Desm. (1873), p. 32. Schaarschm. Magy. Desm. (1883), p. 274. Lemaire Desm. Vosg. (1883), p. 23. Brebisson Liste Desm. (1856), p. 138. Notaris Desm. Ital. (1867), p. 49, t. 6, f. 37. Rabh. Alg. Eur. (1868), p. 217. Wolle Desm. U.S. (1884), p. 148, t. 47, f. 5-8.

Desmidium ramosum, Ehr. Mikr. Leb. S. & N. A. (1843), t. 4, f. 21.

Asteroxanthium ramosum, Kutz. Spec. Alg. (1849), 184.

HAB. In pools.

Sussex, Cornwall, Wales; France, Germany, Sweden, Norway, Spitzbergen, Italy, Hungary, United States.

Plate LIII., fig. 1. *a*, living frond; *b*, empty frond; *c d*, end views.

Staurastrum Griffithsianum. (*Näg.*) *Archer in Micr. Journ.* (1866), *p.* 67.

Of medium size, sub-orbicular, with a narrow sinus, densely clad and margined with short equal truncate processes, which are two to four-toothed at the apex. Semi-cells semi-orbicular, or sub-trapezoid, end view triangular, angles obtuse, sides concave (destitute of spines at the middle).

SIZE. 50 × 50 μ without spines.

Nordst. Desm. Grönl. (1885), p. 11.

Phycastrum Griffithsianum, Näg. Einz. Alg. (1849), 127, t. viii., c. f. 2.

Staurastrum spongiosum, Rabh. Alg. Eur. (1868), p. 217 in part. Lund. Desm. Suec. (1871), p. 65 in part.

HAB. In pools.

Ireland; Germany, Sweden, Greenland.

Plate LIII., fig. 2. *a*, living frond; *b*, empty frond; *c d*, end views.

Staurastrum asperum. *Bréb. in Ralfs. Desm.* (1848), *p.* 139, *t.* 22, *f.* 6; *t.* 23, *f.* 12.

Segments broadly elliptic, rough with minute spines, which, on the outer margin, are usually dilated at the end or forked. Zygospore orbicular, spiny; spines twice branched at the apex.

SIZE. Diam. 40-45 μ (Wo.); length 52 μ; diam. 45 μ.

Archer in Prit. Inf. (1861), p. 740. Cleve. Sver. Desm. (1864), p. 491. Grunow. Desm. Austr. (1858), p. 502. Rabh. Alg. Eur. (1868), p. 209. Wolle Desm. U.S. (1884), p. 127, t. 42, f. 7, 8.

HAB. In ponds, &c.

Cornwall, Lake District; France, Sweden, Austria, United States.

Plate LIII., fig. 4. *a*, living frond; *b*, empty frond; *c d*, end views; *e*, zygospore.

Staurastrum maamense. *Archer Micr. Journ.* (1869), IX., *p.* 200.

Of medium size, one fourth-part longer than broad, sub-oval, apex sub-truncate, deeply constricted in the middle, with a very narrow linear sinus, semi-cells somewhat semi-circular, ventral margin straight, lateral margin crenate with truncate warts, dorsal margin obsoletely eroded, inferior angles sub-truncate, end view triangular, side slightly concave, angles broadly truncate with three granules.

SIZE. Length, 38-42 μ; diam. 30-35 μ (L.).

Nordstedt Norges Desm. (1874), p. 32. Archer in Journ. Bot. (1874), iii., 93.

Staurastrum pseudocrenatum, Lundell Desm. Suec. (1871), p. 65, t. 4, f. 4.

HAB. In mountain pools, amongst *Myriophyllum.*

Ireland, Westmoreland, Scotland; Sweden, Norway.

Plate LIII., fig. 3. *a*, living frond; *b*, empty frond; *c d*, end views.

Staurastrum saxonicum. *Reinsch. Act. Senck.* (1867), *p.* 127, *t.* 24. *c.* 1 (*not. Bulnh.*).

Medium size, about as broad as long. Semi-cells in front view elliptical, side angles rounded, obtuse dorsal margin straight, lateral angles, and above them armed with firm ternate spines, dorsal margin and within it furnished with shortly truncate warts; end view triangular with rounded obtuse, angles, sides straight or a little convex, furnished with a row of warts, outer angles armed with firm ternate spines, within the margin a row of obtuse warts on either side.

SIZE. Length 70-75 μ; diam. 62-67 μ (N.); length 72-80 μ; diam. 58-70 μ (Wi.); length 54 μ; diam. 54 μ (Re.).

Nordst. Desm. Spetz. (1872), p. 40. Wille Nova Zemb. (1879), p. 54. Lemaire Desm. Vosg. (1883), p. 23.

HAB. In pools.

North Wales; France, Germany, Nova Zembla, Spitzbergen.

Plate LIII., fig 5. *a a*, living fronds; *b b*, empty fronds; *c d*, end views.

VI. Segments without spines, end view angles rounded.

† *Frond smooth.*

Staurastrum muticum. *Bréb. in Meneg. Syn. Desm.* (1840).

Segments smooth, elliptic; end view showing slightly concave sides, and three to five rounded angles. Zygospore orbicular, spiny; spines robust, cleft at their apices.

SIZE. Length 35-40 μ; diam. 33-40 μ (N.); diam. 33-38 μ (Wo.).

Ralfs Desm. (1848), p. 125, t. 21, f. 4; t. 34, f. 13. Archer in Prit. Inf. (1861), p. 740. Nordstedt. Desm. Arct. (1875), p. 32. Wille Norges Desm., p. 40. Cleve Sver. Desm. (1864), p. 489. Lundell Desm. Suec. (1871), p. 56. Petit Liste Desm. Paris (1877), p. 31. Grunow Desm. Austr. (1858), p. 501. Wittrock Scan. Desm. (1869), p. 16. Wood F. Water Algæ U.S. (1872), p. 148. Notaris Desm. Ital. (1867), p. 55, t. 5, f. 53. Rabh. Alg. Eur. (1868), p. 200. Schaarschm. Magy. Desm. (1883), p. 270. Brebisson Liste Desm. (1856), p. 144. Nordstedt. Desm. Spitz. (1872), p. 38. Jacobsen. Desm. Denm. (1874), p. 202 partly. Lemaire Desm. Vosg. (1883), p. 23. Wolle Desm. U.S. (1884), p. 119, t. 39, f. 11-15.

Phycastrum muticum, Kutz. Spec. Alg. (1849), 178.
Staurastrum trilobum, Meneg. Consp. Alg. (1837), p. 18.
Binatella muticum, Breb. Alg. Fal. (1835), p. 57, t. 8.
Phycastrum depressum, Näg. Einz. Alg. (1849), p. 126, t. 8 A., f. 1.

HAB. In ponds.

Westmoreland, Cornwall, Wales; France, Germany, Sweden, Norway, Denmark, Spitzbergen, Austria, Hungary, Italy, United States.

Plate LI., fig. 6. *a*, living frond; *b*, empty frond; *c d e*, end views.

Staurastrum orbiculare. *Ralfs. Ann. Nat. Hist.* (1845), xv., *p.* 152, *t.* 10.

Segments smooth, semi-orbicular; end view bluntly triangular. Zygospore orbicular, beset with subulate spines.

SIZE. Length 28 μ; diam. 25 μ (D.); diam. 30-45 μ (Wo.); diam. 22-50 μ (K.). Length 32 μ; diam. 27 μ (N.).

Ralfs Desm. (1848), p. 125, t. 21, f. 5. Archer in Prit. Inf. (1861), p. 740. Wille Norges Desm., p. 40. Delponte Desm. (1878), t. 10, f. 5-12 partly. Nordst. Desm. Arct. (1875), p. 32. Wittr. Sotr. Alg., p. 54. Cleve Sver. Desm. (1864), p. 489. Kirchn. Alg. Schles. (1878), p. 164. Lundell Desm.

Suec. (1871), p. 56. Nordstedt Norges Desm. (1873), p. 26. Petit Liste Desm. Paris (1877), p. 31. Grunow Desm. Austr. (1858), p. 498, 502. Nordst. & Wittr. Desm. Ital. (1876), p. 42. Schaarschm. Magy. Desm. (1883), p. 272. Wittrock Scan. Desm. (1869), p. 16. Wood F. Water Algæ U.S. (1872), p. 148. Brebisson Liste Desm. (1856), p. 144. Notaris Desm. Ital. (1867), p. 55, t. 5, f. 53. Rabh. Alg. Eur. (1868), p. 200. Wille Nov. Sem. (1879), p. 49. Jacobsen Desm. Denm. (1874), p. 202. Lemaire Desm. Vosg. (1883), p. 23. Nordst. Desm Bras. (1869), p. 224. Wolle Desm. U.S. (1884), p. 120, t. 39, f. 9-10.

Desmidium orbiculare, Ehr. Abh. Berl. Ak. (1832), p. 282. Ehr. Inf. (1838), p. 141, t. 10, f. 9.

Phycastrum orbiculare, Kutz. Phy. Germ. (1845), p. 137.

Goniocystis (Trigonocystes) orbicularis, Hass. Fr. Alg. (1845), p. 349.

Hab. In ponds.

Sussex, Kent, Hants, West Yorkshire, Westmoreland, Cornwall, Wales, Scotland; France, Germany, Sweden, Norway, Denmark, Spitzbergen, Nova Zembla, Austria, Hungary, Italy, Brazil, United States.

Plate LI., fig. 7. *a a*, living fronds; *b c*, empty fronds; *d e f*, end views; *g*, zygospore.

var. *β*. **extensum.** *Nordst. Norges Desm., p.* 26, *f.* 10.

Size. Length 46-48 μ; diam. 33-36 μ (N.).

Hab. In gelatinous coating of rocks.

Scotland.

Staurastrum pygmæum. *Breb. in Ralfs Desm.* (1848), *p.* 213, *t.* 35, *f.* 26.

Segments in front view cuneiform, outer margin slightly convex, smooth, end view with three blunt angles, sides slightly convex. Zygospore orbicular, beset with protuberances, bearing each two bifurcate spines at their summits.

Size. Length 32-34 μ; diam. 27-34 μ (Witt.), 40 × 38 μ (N.).

Archer in Pritch. Infus. (1861), p. 740. Wittr. Sotv. Alg. (1872), p. 53, t. 4, f. 10. Nordst. Norges Desm. (1873), p. 29. Wille Norges Desm. (1880), p. 42. Wille Nova Sem. (1879), p. 51. Nordst. Desm Arct. (1873), p. 34. Nordst. Desm. Grönl. (1885), p. 10. Wolle Desm. U.S. (1884), p. 125, t. 42, f. 14-21.

Hab. In pools.

France, Germany, Norway, Nova Zembla, Greenland, United States.

Plate LIV., fig. 1. *a*, living frond; *b*, empty frond; *c d*, end views.

Staurastrum lanceolatum. *Archer in Micr. Journ.* (1862) 248, *t.* 12, *f.* 16-22.

Frond minute, segments smooth, broadly lanc extremities acute, minutely apiculate; end view tria angles minutely apiculate, sides concave.

Size. Length 25 μ; diam. 33 μ (N.), 25 × 25 μ.

Lundell Desm. Suec. (1871), p. 60. Nordstedt Arct. (1875), p. 33. Rabh. Alg. Eur. (1868), p. 202. Will Sem. (1879), p. 51. Nordstedt Desm. Spitz. (1872), Nordst. Desm. Grönl. (1885), p. 10.

Hab. In pools, coating *Sphagnum*.

Ireland; Spitzbergen, Sweden, Germany, Bavaria, land, Nova Zembla.

Plate LIV., fig. 2. *a*, living frond; *b*, empty frond; *c d*, end *e f*, zygospores.

Staurastrum inconspicuum. *Nordst. Norges Desm.* (1873) *f.* 11.

Very minute, about as long as broad; constriction a rounded sinus; segments quadrate, upper angles pr into a long process, each obliquely directed upwards about half its length suddenly narrowed, present knobbed-like appearance at that point, upper portio more obliquely directed upwards, end truncate, upper m truncate, end view four radiate, sides concave.

Size. Length 14-15½ μ; diam. 14-15 μ without rays diam. 14-16 μ (Wo.).

Archer Quart. Journ. Micr. Sci. x (1870), p. 89. Bot. iii. (1874), p. 91. Wolle Desm. U.S. (1884), p t. 53, f. 4-5.

Hab. In ponds.

Cornwall, South and West of Ireland, Norway, States.

Plate LIV., fig. 3. *a*, living frond; *b*, empty frond; *c*, end *d*, front view further enlarged.

†† *Segments having the projecting portions surround annular transverse lines (puncta or granules).*

Staurastrum striolatum. *(Näg.) Pritch. Infus.* (1861),

Segments in front view reniform, divergent, ends co each of the lateral portions crossed by about five tran lines (annular rows of closely set puncta or minute gra end view with three rounded angles, sides concave, e the projections crossed, as before, by about five tran lines, the central portion smooth.

SIZE. Length 20-22 μ; diam. 19-22 μ (N.); diam, 22-35 μ (W.); diam. 22-30 μ (K.).

Lundell Desm. Suec. (1871), p. 57. Nordst. Norges Desm. (1873), p. 26. Wittr. Sotv. Alg. (1872), p. 52. Schaarschm. Magy. Desm. (1883), p. 272. Nordst. Desm. Bras. (1869), p. 225. Wolle Desm. U.S. (1884), p. 126, t. 51, f. 27-28. Kirchn. Alg. Schles. (1878), p. 164.

Phycastrum striolatum, Näg. Einz. Alg. (1849), p. 126, t. viii. a, fig. 3.

HAB. In ponds.

Germany, Sweden, Norway, Hungary, Brazil, United States.

Plate LIV., fig. 4. *a*, living frond; *b*, empty frond; *c d e*, end views.

††† *Fronds rough superficially with scattered granules.*

Staurastum muricatum. *Breb. in Meneg. Syn. Desm.* (1840), *p.* 226.

Segments semi-orbicular, rough with conic granules, end view triangular, with
angles.

SIZE. Length 50-72
(K.).

Ralfs Desm. (1848).
Inf. (1861), p. 740. W.
Schles. (1878), p. 164.
Cleve Sver. Desm. (1864
(1873), p. 29. Petit Liste Desm. Paris (1877), p. 31. Brebisson Liste Desm. (1856), p. 141. Jacobsen Desm. Denm. (1874), p. 205. Schaarschm. Magy. Desm. (1883), p. 273. Notaris Desm. Ital. (1867), p. 50, t. 4, f. 42. Rabh. Alg. Eur. (1868), p. 208. Wolle Desm. U.S. (1884), p. 127, t. 42, f. 3-6.

Staurastrum muricatum, β., Ralfs Ann. Nat. Hist. (1845), xv., p. 154, t. 11, f. 1, *d e.*

Binatella muricata, Breb. Alg. Fal. (1835), p. 66.

Desmidium apiculosum, Ehr. Inf. (1838), p. 142.

Xanthidium deltoideum, Corda Alm. Carls. (1840), t. 5, f. 38-39.

Phycastrum apiculosum, Kutz. Phy. Germ. (1845), p. 137.

Goniocystis (Trigonocystis) muricata, var. β., Hass. Fr. Alg. (1845), p. 351, t. 84, f. 10.

HAB. In ponds.

Sussex, Westmoreland, Wales, Cornwall; France, Germany, Norway, Sweden, Denmark, Italy, Hungary, United States.

Plate LIV., fig. 5. *a*, living frond; *b*, empty frond; *c d*, end views.

Staurastum punctulatum. *Bréb. in Ralfs Desm.* (1848), *p.* 133, *t.* 22, *f.* 1.

Segments rough with puncta-like granules, elliptic, equal, end view with broadly rounded angles, and slightly concave sides. Zygospore globose, spines long, rather broad at the base, dichotomous at the apex.

SIZE. Length 45-50 μ; diam. 38-43 μ (N.); diam. 28-36 μ (K.); zygospore 29 μ; spines 14 μ (L.); length 27 μ; diam. 28 μ (D.).

Archer in Prit. Inf. (1861), p. 740. Wittr. Sotv. Alg. p. 53. Delponte Desm. (1878), t. 11, f. 33-38. Kirchn. Alg., Schles. (1878), p. 164. Nordstedt Desm. Arct. (1875), p. 34-41. Cleve Sver. Desm. (1864), p. 490. Lundell Desm. Suec. (1871), p, 63. Nordstedt Norges Desm. (1873), p. 29. Petit Liste Desm. Paris (1877), p. 31. Grunow Desm. Austr. (1858), p. 502. Wille Norges Desm. p. 42. Wittrock Scan. Desm. (1869), p. 18. Jacobsen Desm. Denm. (1874), p. 205. Schaarschm. Magy. Desm. (1883), 273. Mask. New Zeal. Desm. (1882), p. 244. Wood F. Water Algæ U.S. (1872), p. 151. Brebisson Liste Desm. (1856), p. 144. Notaris Desm. Ital. (1867), p. 51, t. 4, f. 44. Rabh. Alg. Eur. (1868), p. 208. Nordstedt Desm. Spitz. (1872), p. 39. Lemaire Desm. Vosg. (1883), p. 23. Nordst. Desm. Grönl. (1885), p. 10. Wolle Desm. U.S. (1884), p. 127, t. 41, f. 43-45.

HAB. In ponds.

Sussex, Westmoreland, West Yorkshire, Essex, Wales, Cornwall; France, Germany, Sweden, Norway, Denmark, Nova Zembla, Spitzbergen, Austria, Hungary, Italy, Greenland, United States, New Zealand.

Plate LIV., fig. 6. *a*, living frond; *b*, empty frond; *c d*, end views.

Staurastrum pileolatum. *Bréb. in Ralfs Desm.* (1848), *p.* 215, *t.* 35, *f.* 22.

Frond quadrilateral, slightly constricted at the middle, segments terminated by three conical processes, end view triangular, angles rounded.

SIZE. Length 48 μ; diam. 23 μ.

Brebisson Liste Desm. (1856), p. 145. Close in Micr. Journ. (1873), xiii., p. 99. Rabh. Alg. Eur. (1868), p. 220.

HAB. On rocks.

Devonshire, Ireland, Scotland; France.

Plate LV., fig. 1. *a*, living frond; *b*, empty frond; *c d*, end views.

Staurastrum capitulum. *Breb. in Ralfs Desm.* (1848), *p.* 214, *t.* 35, *f.* 25.

Segments in front view quadrate, sides with a rounded sinus at the middle, the basal and upper angles crenated, rounded, upper margin straight, end view with three broadly rounded crenated angles, sides nearly straight, each with a slight shallow depression or constriction at the middle.

SIZE. Length 40 μ ; diam. 24 μ (K.).

Archer in Pritch. Infus. (1861), p. 741. Kirchn. Alg. Schles. (1878), p. 165.

HAB. In pools.

France, Germany.

var. **amænum.** *Hilse in Rabh. Fl. Eur.* III., 209.

Semi-cells dilated upwards, base verrucose.

Nordst. Norges Desm. (1873), p. 29. Wille Nova Sem. (1879), p. 54. Lemaire Desm. Vosg. (1883), p. 23. Kirchn. Alg. Schles. (1878), p. 165.

SIZE. Length 38-45 μ ; diam. 28 μ (N.) ; diam. 25 μ (K.).

HAB. In pools.

Dartmoor, Scotland ; France, Germany, Norway, Nova Zembla.

Plate LV., fig. 3. *a*, living frond ; *b*, empty frond ; *c d e*, end views.

var. **spetzbergense.** *Nordst. Desm. Spetz., p.* 39, *t.* 7, *f.* 25.
Lake District.

Staurastrum Meriani. *Reinsch. Alg. Fl.* (1867), *p.* 160, *t.* XII., *f.* 1.

Cells in front view obtuse angled. Segments in front view trapezoid, almost rectangular, end view triangular, quadrangular, pentagonal or hexagonal, lateral margins straight, or slightly emarginate, angles rounded, obtuse, cell membrane densely warted, warts disposed in parallel series at the angles.

SIZE. Length 37-46 μ ; diam. 18-30 μ (Re.).

Reinsch. Act. Senkenl. vi., p. 125, t. 23, d. 1. Crowe Micr. Journ. xiii. (1873), p. 437. Nordstedt Norges Desm. (1873), p. 29. Nordst. and Wittr. Desm. Ital. (1876), p. 42. Lemaire Desm. Vosg. (1883), p. 23. Nordst. Desm. Grönl. (1885), p. 10. Wolle Desm. U.S. (1884), p. 132, t. 46, f. 17-19.

HAB. In pools.

West Yorkshire, Lake District, Ireland, Scotland ; France, Germany, Norway, Greenland, Italy, United States.

Plate LV., fig. 3. *a*, living frond ; *b*, empty frond ; *c d e*, end views.

Staurastrum alternans. *Breb. in Ralfs Desm.* (1848), *p.* 132, *t.* 21, *f.* 7.

Segments rough, narrow-oblong, and, from their twisted position, unequal in front view; end view with the angles of one segment entire, and alternating with those of the other. Zygospore orbicular, spiny; spines forked at the apex.

SIZE. Length and breadth 21-39 μ (D.).

Archer in Prit. Inf. (1861), p. 741, t. 2, f. 16, 17. Delponte Desm. (1878), t. 11, f. 39-47. Cleve Sver. Desm. (1864), p. 491. Nordstedt Norges Desm. (1873), p. 29. Grunow Desm. Austr. (1858), p. 498. Wood F. Water Algæ U.S. (1872), p. 150. Brebisson Liste Desm. (1856), p. 144. Wille Nova Sem. (1879), p. 53. Wittr. Sottv. Alg. (1872), p. 52. Mask. New Zeal. Desm. (1882), p. 243. Wolle Desm. U.S. (1884), p. 128, t. 41, f. 26-28.

Staurastrum tricorne, Ralfs Ann. Nat. Hist. (1845), xv., p. 141, t. 11, f. 2.

Goniocystis (*Trigonocystis*) *hexaceros*, Hass. Fr. Alg. (1845), p. 352.

Staurastrum dispar, Breb. List. Desm. (1856), p. 144 ?.

HAB. In ponds.

Sussex, Surrey, Kent, Hants, Gloucestershire, Westmoreland, Cornwall, Wales, Scotland; France, Germany, Sweden, Norway, Denmark, Austria, Italy, Nova Zembla, United States, New Zealand.

Plate LIV., fig. 7. *a*, living frond; *b*, empty frond; *c d*, end views; *e*, zygospore.

Staurastrum dilatatum. *Ehr. Infus.* (1838), *p.* 143, *t.* 10, *f.* 13.

Segments rough, fusiform, equal; end view with four short, broad, truncate, entire rays.

SIZE. Diam. 20-28 μ (K.).

Ralfs Desm. (1848), p. 133, t. 21, f. 8. Archer in Prit. Inf. (1861), p. 741. Nordst. Desm. Grönl. (1885), p. 10. Ralfs Ann. Nat. Hist. (1845), xv., p. 143, t. 11, f. 5. Lundell Desm. Suec. (1871), p. 63. Nordstedt Norges Desm. (1873), p. 29. Petit Liste Desm. Paris (1877), p. 31. Wood F. Water Algæ U.S. (1872), p. 150. Brebisson Liste Desm. (1856), p. 140. Kirchn. Alg. Schles. (1878), p. 165. Rabh. Alg. Eur. (1868), p. 207, in part. Jacobsen Desm. Denm. (1874), p. 206, in part. Schaarschm. Magy. Desm. (1883), p. 273. Mask. New Zeal. Desm. (1882), p. 243. Lemaire Desm. Vosg. (1883), p. 23. Wolle Desm. U.S. (1884), p. 128, t. 52, f. 32, 33.

Phycastrum dilatatum, Kutz. Phyc. Germ. (1845), p. 138.

Goniocystis (*Staurastrum*) *dilatata*, Hass. Fr. Alg. (1845), p. 353.

Hab. In ponds.

Kent, Sussex, Gloucestershire, West Yorkshire, Westmoreland, Cornwall, Wales; France, Germany, Norway, Sweden, Denmark, Greenland, Hungary, United States, New Zealand.

Plate LIV., fig. 8. *a*, living frond; *b*, empty frond; *c d*, end views.

Staurastrum Kjellmanni. *Wille Nov. Sem.* (1879), *p.* 50, *t.* XIII., *f.* 50-53.

Medium size, about one-third or one-fourth part longer than broad, constricted in the middle, with a broad acute-angled sinus; semi-cells dilated from the middle upwards, angles more or less rounded, dorsal margin broadly rounded, end view 3-4 or 5-sided, sides slightly convex or concave, sometimes straight, angles rounded. Membrane longitudinally granulated.

Size. Length 46-48 μ; diam. 38-40 μ; or 38 μ × 42 μ, or 46-48 μ × 34-38 μ (Wi.).

Hab. In pools.

Lake District (England); Nova Zembla.

Plate LIV., fig. 9. *a*, living frond; *b*, empty frond; *c d e*, end views.

VII. Segments with or without spines · in front view
spines (if any) few and scatt
emarginate, or bifid, or trunc
plane and quadrangular.

Staurastrum bifidum. *Breb. in Ralfs Desm.* (1848), *p.* 215.

Medium size, about as long as broad, median incision deep; semi-cells subelliptical, triangular, produced on each side into an oblique acuminate spine. End view with three acutely bifid or emarginate angles, the teeth acute, sides concave, membrane smooth.

Size. Length 30-33 μ; diam. 33 μ, with spines 48 μ (L.); length 30-33 μ; diam. 33 μ (K.).

Marquand in Desm. Cornw. (1883), p. 7. Pritch. Infus. (1861), p. 741. Lundell Desm. Suec. (1871), p. 62, t. 4, fig. 2. Kirchn. Alg. Schles. (1878), p. 169. Nordst. de Algis (1880), p. 10.

Desmidium bifidum, Ehr. Abh. Berl. Akad. (1832), p. 292. Infus. p. 141, t. 10, f. 11.

Phycastrum bifidum, Kutz. Phyc. Germ. (1845), p. 138.

Hab. In pools.

Cornwall; France, Germany, Sweden, Java.

Plate LVII., fig. 3. *a*, living frond; *b*, empty frond: *c d*, end views

Staurastrum quadrangulare. *Breb. in Ralfs Desm.* (1848), *p.* 128, *t.* 22, *f.* 7.

Frond smooth ; segments quadrangular, with a few marginal spines or teeth ; end view [illegible], with truncate angles, either emarginate or dentate.

Size. Diam. 22-26 μ (K.) ; diam 23-30 μ (Wo.).

Kirchn. Alg. Schles. (1878), p. 170. Archer in Prit. Inf. (1861), p. 741, t. 3, f. 24-25. Lundell Desm. Suec. (1871), p. 64. Nordstedt Norges Desm. (1873), p. 31. Rabh. Alg. Eur. (1868), p. 215. Nordst. Desm. Bras. (1869), p. 229. Wolle Desm. U.S. (1884), p. 145, t. 41, f. 1-4.

Hab. In pools.

Westmoreland ; France, Germany, Sweden, Norway, Brazil, United States.

var. β **major.** *Ralfs Desm., p.* 129, *t.* 34, *fig.* 11.

Angles in end view broader, with four teeth at the extremity, and two minute teeth on upper side.

Hab. In pools.

England ; France.

Plate LV., fig. 4. *a,* living frond; *b b,* empty fronds ; *c d,* end views.

Staurastrum quadrispinum. *Turn. Naturalist* (1886), *p.* 35, *t.* 1, *f.* 4.

Of medium size, much longer than broad, frond smooth, or slightly punctate, each angle of the segments bearing four stout divergent spines; ends of segments slightly concave, sinus wide, expanding rapidly.

Size. Long 34 μ; diam. 26 μ; isthmus 8 μ; spines 10 μ (T.).

Hab. In pools.

Monmouth (Wales) ; United States.

Plate LV., fig. 5. *a,* living frond ; *b,* empty frond ; *c d,* end views. From figures by W. B. Turner.

Staurastrum longispinum (*Bailey*). *Archer in Pritch. Infus.* (1861), *p.* 743.

Segments in front view triangular, truncate, on outer margin smooth, terminating at each side in two much elongated stout processes, subacute at the apex, placed one above the other, divergent; end view with three angles, each extremity terminated by a process, and having the other immediately above it on the upper surface, side straight.

Size. 96-108 × 90-102 μ.

Archer Micr. Journ. xii. (1872), p. 199 ; xvii. (1877), p. 192. Wood F. W. Alg. U.S. (1872), p. 148. Lundell Desm. Suec. (1871), p. 73. Nordstedt Norges Desm. (1873), p. 37.

Wood F. Water Algæ U.S. (1872), p. 148. Rabh. Alg. Eur. (1868), p. 221. Wolle Desm. U.S. (1884), p. 145, t. 41, f. 7.

Staurastrum didentatum, Wittr. Anteck 1869, p. 16, f. 7.

Didymocladon longispinum, Bailey Micr. Obs. (1850), pl. 1, f. 17.

HAB. In pools, &c.

Ireland; Sweden, Norway, United States.

Plate LVI., fig. 1. *a*, living frond; *b*, empty frond; *c d*, end views.

Staurastrum Brasiliense. *Lundell Desm. Suec.* (1871), *p.* 73, *t.* 5. *f.* 2.

Large, about one-third part longer than broad, deeply constricted, with a broad sinus, semi-cells shortly cuneate, dilated upwards, dorsal margin truncate, or a little retuse, angles with three firm divergent spines; end view four (or five) angled, angles terminating in three firm long divergent spines, sides concave, membrane punctate.

SIZE. Length 43-51 μ; diam 25-37 μ; spines 13-25 μ (N.).

Nordst. Norges Desm. (1873), 70. Wolle Desm. U.S. (1884), p. 146, t. 48, f. 1-3 (scarcely Nordst. Desm. Bras. (1869), p. 227, t. iv., f. 39.)

HAB. In mountain pools.

North Wales, Ireland; Sweden, Norway (Brazil ?).

Plate LVI., fig. 2. *a*, living frond; *b*, empty frond; *c d*, end views.

VIII. Segments without spines, in front view and end view angles terminated by either a conspicuous rounded nipple-like projection, or enlarged rounded knob, or an elongate capitate process.

Staurastrum tumidum. *Breb. in Ralfs Desm.* (1848), *p.* 126, *t.* 21, *f.* 6.

Segments smooth, elliptic or sub-orbicular, end view bluntly triangular, each angle terminated by a nipple-like projection; empty frond minutely punctate, zygospore ovoid, with a thick membrane clad with scattered conic obtuse spines.

SIZE. Zygospore length 126 μ; diam. 92 μ; spines 14 μ (L.); length 176 μ; diam. 92 μ (C.); diam. 112 μ (Wo.).

Wille Norges Desm. (1880), p. 47. Archer in Prit. Inf. (1861), p. 741. Cleve Sver. Desm. (1864), p. 489. Lundell Desm. Suec. (1871), p. 72, t. 4, f. 10. Nordstedt Norges Desm. (1873), p. 37. Petit Liste Desm. Paris (1877), p. 31. Brebisson Liste Desm. (1856), p. 143. Rabh. Alg. Eur. (1868), p. 201. Jacobsen Desm. Denm. (1874), p. 203. Wolle Desm. U.S. (1884), p. 120, t. 39, f. 1-2.

Binatella tumida, Breb. Alg. Fal. (1835), p. 66.
Staurastrum orbiculare, Meneg. Syn. Desm. (1840), p. 225.
Phycastrum tumidum, Kutz. Spec. (1849), p. 179.

HAB. In ponds.

Sussex, Cornwall, Lake District, Wales; France, Germany, Sweden, Norway, Denmark, United States.

Plate LV., fig. 8. *a*, living frond of narrow form; *b*, zygospore.

Plate LVII., fig. 1. *a*, living frond; *b*, end view with hyaline envelope; *c*, empty frond; *d*, end view.

Staurastrum grande. *Buln. Hedw.* (1863), *p.* 51, *t.* IX. *a, f.* 14.

Large, a little longer than broad, with a deep acute-angled sinus; semi-cells elliptic, end view three or four-angled, sides slightly concave, angles obtuse; membrane delicately punctate.

SIZE. Length 84-88 μ; diam. 80-82 μ (L.); diam. 75-83 μ (Wo.).

Lundell Desm. Suec. (1871), p. 72, t. 4, f. 11. Wolle Desm. U.S. (1884), p. 120, t. 39, f. 3-4.

HAB. In boggy pools.

North Wales; Germany, Sweden, United States.

Plate LVII., fig. 2. *a*, living frond; *c*, empty frond; *b d*, end views.

Staurastrum aversum. *Lundell Desm. Suec.* (1871), *p.* 59, *t.* 3, *f.* 27.

Medium size, about one-fourth part longer than broad, deeply constricted, sinus acute-angled; semi-cells obversely elliptico-semi-circular, dorsal margin truncate or very slightly concave, furnished at each pole with a minute rounded spine like a papilla, end view triangular, angles truncately rounded, furnished with a very short spine, sides very slightly concave, membrane delicately punctate.

SIZE. Length 43-52 μ; diam. 36-42 μ (L.).

Nordst. Norges Desm., p. 27. Archer in Journ. Bot. (1874), iii., p. 93.

Staurastrum brevispina, Cleve Sver. Desm., p. 489.

HAB. In pools.

Ireland; Sweden, Norway.

Plate LV., fig. 6. *a*, living frond; *b c*, empty fronds; *d e*, end views.

IX. Segments, in front view, with the opposite lateral extremities each tapering into a more or less elongate colourless process divided at the apex, which in end view terminates the angles, with or without intermediate simple or truncate spines.

† *Segments smooth.*

Staurastrum brachiatum. *Ralfs Ann. Nat. Hist.* (1845), xv., *p.* 151, *t.* 10, *f.* 3.

Frond smooth, front view with thick diverging processes, which are deeply bifid or trifid at the apex; end view with three or four rays. Zygospore quadrate, spiny; spines few, subulate.

SIZE. Diam. 33-55 μ (Wo.).

Ralfs Desm. (1848), p. 131, t. 23, f. 9. Archer in Prit. Inf. (1861), p. 741. Cleve Sver. Desm. (1864), p. 491. Lundell Desm. Suec. (1871), p. 62. Nordstedt Norges Desm. (1873), p. 28. Petit Liste Desm. Paris (1877), p. 31. Brebisson Liste Desm. (1856), p. 139. Notaris Desm. Ital. (1867), p. 54, t. 5, f. 50. Rabh. Alg. Eur. (1868), p. 205. Jacobsen Desm. Denm. (1874), p. 208. Wille Norges Desm. (1880), p. 41. Lemaire Desm. Vosg. (1883), p. 23. Wolle Desm. U.S. (1884), p. 124, t. 40, f. 37-39, t. 52, f. 29-31.

Goniocystis (Staurastrum) bifida, Hass. Fr. Alg. (1845), p. 355.

Phycastrum Ralfsii, Kutz. Spec. (1849), p. 181.?

HAB. In ponds.

Gloucester, Westmoreland, Sussex, Cornwall, Wales, Scotland; France, Germany, Sweden, Norway, Denmark, Italy, Hungary, Switzerland, United States.

Plate LVIII., fig. 1. *a*, living fronds; *b*, empty fronds; *c c*, end views; *d e*, zygospores.

†† *Segments rough with superficial granules, those of the processes in transverse lines.*

Staurastrum tricorne. (*Breb.*) *Meneg. Syn. Desm.* (1840), *p.* 225.

Frond rough with puncta-like granules, segments tapering at each side with a short blunt, mostly entire process, end view with three or four blunt angles. Zygospore orbicular, spiny; spines divided at the apex.

SIZE. Length 40 μ; diam. 40-45 μ (N.); length 30 μ; diam. 36 μ (D.).

Ralfs Desm. (1848), p. 134, t. 22, f. 11; t. 34, f. 8. Archer in Prit. Inf. (1861), p. 742. Delponte Desm. (1878), t. 11, f.

48-50. Nordstedt Desm. Arct. (1875), p. 33, 39. Kirch. Alg. Schles. (1878), p. 165. Cleve Sver. Desm. (1864), p. 491. Lundell Desm. Suec. (1871), p. 63. Grunow Desm. Austr. (1858), p. 498. Wittrock Scan. Desm. (1869), p. 19. Brebisson Liste Desm. (1856), p. 140. Schaarschm. Magy. Desm. (1883), p. 270. Mask. New Zeal. Desm. (1882), p. 243. Wood F. Water Algæ U.S. (1872), p. 150. Nordstedt Desm. Spitz. (1872), p. 38. Lemaire Desm. Vosg. (1883), p. 23. Wolle Desm. U.S. (1884), p. 126, t. 41, f. 36-38.

Staurastrum dilatatum c. tricorne, Rabh. Alg. Eur. (1868), p. 207.

Binatella tricornis, Breb. Alg. Fal. (1835), p. 57, t. 8.

Desmidium hexaceros, Ehr. Infus. (1838), p. 141, t. 10, f. 10.

Phycastrum tricorne, Kutz. Phy. Germ. (1845), p. 137.

Phycastrum trilobatum, Kutz. Spec. (1849), p. 179.

Phycastrum hexaceros, Kutz. Spec. (1849), p. 180.

Phycastrum Ralfsii, Näg. Einz. Alg. (1849), p. 125.

Phycastrum crenulatum, Näg. Einz. Alg. (1849), t. 8, b, in part.

HAB. In ponds and pools.

Sussex, Westmoreland, Cornwall, Wales; France, Germany, United States, Spitzbergen, Sweden, Nova Zembla, Hungary, Italy, Austria, New Zealand.

Plate LVIII., fig. 2. *a*, living frond; *b*, empty frond; *c d*, end views.

var. *β*. *Ralfs Desm.* (1848), *p.* 134, *t.* 34, *f.* 8, *b c d.*

Processes terminated by minute spines.

Wittrock Scan. Desm. (1869), p. 19. Lundell Desm. Suec. (1871), p. 63.

HAB. In ponds.

Sussex, Cornwall.

Plate LXIV., fig. 5. *a*, living frond; *b*, empty frond; *c d*, end views; *e*, zygospore.

Staurastrum cyrtocerum. *Breb. in Ralfs Desm.* (1848), *p.* 139, *t.* 22, *f.* 10.

Frond rough with minute granules; segments in front view somewhat triangular with short incurved processes. Zygospore orbicular, spiny; spines slightly forked at the apex.

SIZE. Length 31 μ; diam. 33 μ (W.); length 23 μ; diam. 33 μ (N.).

Wolle Desm. U.S. (1884), p. 128, t. 42, f. 30, 31. Archer in Prit. Inf. (1861), p. 742. Nordstedt. Norges Desm. (1873), p. 33. Brebisson Liste Desm. (1856), p. 139. Jacobsen Desm. Denm. (1874), p. 206. Wittrock Sotv. Alg. (1872), p. 51.

Phycastrum cyrtocerum, Kutz. Spec. (1849), p. 180.

Staurastrum polymorphum var. cyrtocerum, Wood F. Water Algæ U.S. (1872), p. 151. Rabh. Alg. Eur. (1868), p. 209.

HAB. In ponds.

Gloucestershire, Sussex, Cornwall, Wales ; France, Norway, Sweden, Denmark, United States.

Plate LVIII., fig. 3. *a*, living frond; *b*, empty frond; *c d*, end views.

Staurastrum arcuatum. *Nordst. Norges Desm.* (1873), *p.* 36, *f.* 18.

Rather small, about one-third broader than long, constriction deep, expanding; segments elliptic, divergent (obversely lunate) angles furnished with short geminate divergent spines, on the upper surface at each side a pair of intermediate short bifid spines, surface granulate, granules in transverse lines ; end view triradiate, sides concave.

SIZE. Length 20 μ ; diam. 29 μ (N.).

Archer in Journ. Bot. iii. (1874), p. 92. Wolle Desm. U.S. (1884), p. 139, t. 46, f. 13, 14, var.

HAB. In mountain pools.

Ireland ; Norway, United States.

Plate LI., fig. 2. *a*, living frond ; *b*, empty frond ; *c d e*, end views.

Staurastrum inflexum. (*Breb.*) *Pritch. Infus.* (1861), *p.* 742.

Segments in front view broadly elliptic, inner and outer margin turgid, rough with minute granules, lateral processes incurved, short, divided at the apex ; end view three or four-radiate, processes short, sides concave.

SIZE. Length 35 μ ; diam., with arms, 45 μ.

Lemaire Desm. Vosg. (1883), p. 23. Cooke in Journ. Quekett Club (1880), t. 16, f. 38.

HAB. In pools.

Lake District, North Wales ; France.

Plate LVIII., fig. 5. *a*, living frond ; *b b*, empty fronds ; *c d*, end iews.

taurastrum polymorphum. *Breb. in Ralfs. Desm.* (1848), *p.* 135, *t.* 22, *f.* 9 ; *t.* 34, *f.* 6.

Segments rough with minute granules, having on each ide a short process tipped with spines ; end view three to ix-rayed. Zygospore orbicular, spiny ; spines few, forked t the apex.

SIZE. Length 45-53 μ ; diam. 53 μ (N.) ; length 21-35 μ ;

diam. 21-35 μ (D.); length 25 μ; diam. 20 μ (K.); diam. 25-30 μ (Wo.).

Wille Norges Desm. p. 43. Archer in Prit. Inf. (1861), p. 742, t. 2, f. 20, 21, 24, 25, 31. Delponte Desm. (1878), t. xi., f. 56-62. Notaris Desm. Ital. (1867), t. 4, f. 46. Nordstedt Desm. Arct. (1875), p. 34, 41. Cleve Sver. Desm. (1864), p. 491. Lundell Desm. Suec. (1871), p. 67. Nordstedt Norges Desm. (1873), p. 33. Petit Liste Desm. Paris (1877), p. 31. Wittrock Scan. Desm. (1869), p. 18. Wittr. Sotv. Alg., 51. Wood. F. Water Algæ U.S. (1872), p. 151. Schaarschm. Magy. Desm. (1883), p. 274. Kirch. Alg. Schles. (1878), p. 167. Brebisson Liste Desm. (1856), p. 139. Notaris Desm. Ital. (1867), p. 52, t. 4, f. 46. Rabh. Alg. Eur. (1868), p. 209, in part. Wille Nov. Sem. (1879), p. 53. Nordstedt Desm. Spitz. (1872), p. 39. Jacobsen Desm. Denm. (1874), p. 206. Lemaire Desm. Vosg. (1883), p. 24. Nordst. Desm. Bras. (1869), p. 228. Wolle Desm. U.S. (1884), p. 126, t. 42, f. 9, 10, 24, 25.

Hab. In ponds.

Sussex, Surrey, Westmoreland, Cornwall; France, Germany, Sweden, Norway, Denmark, Spitzbergen, Nova Zembla, Russian Lapland, Italy, Hungary, Brazil, United States.

Plate LVIII., fig. 4. *a*, living frond; *b b*, empty fronds; *c d*, end views; *e*, zygospore.

Staurastrum gracile. *Ralfs Ann. Nat. Hist.* (1845), xv., *p.* 155, *t.* 11, *f.* 3.

Segments rough, elongated on each side into a slender process which is terminated by minute spines; end view triradiate.

Size. Length 72 μ; diam. 50 μ (D.); length 42 μ; diam. 55-60 μ (K.); diam. 40-50 μ (Wo.).

Ralfs Desm. (1848), p. 136, t. 22, f. 12. Archer in Prit. Inf. (1861), p. 742, t. 3, f. 28, 29. Kirchn. Alg. Schles. (1878), p. 167. Delponte Desm. (1878), t. 12, f. 12-21. Notaris Desm. Ital. (1867), t. 5, f. 49. Cleve Sver. Desm. (1864), p. 491. Lundell Desm. Suec. (1871), p. 68. Nordstedt Norges Desm. (1873), p. 34. Petit Liste Desm. Paris (1877), p. 31. Wittrock Scan. Desm. (1869), p. 18. Wood F. Water Algæ U.S. (1872), p. 152. Brebisson Liste Desm. (1856), p. 139. Wille Norges Desm. (1880), p. 46. Schaarschm. Magy. Desm. (1883), p. 274. Notaris Desm. Ital. (1867), p. 54, t. 5, f. 49. Rabh. Alg. Eur. (1868), p. 211. Jacobsen Desm. Denm. (1874), p. 207. Lemaire Desm.

Vosg. (1883), p. 24. Nordst. Desm. Bras. (1869), p. 229. Wolle Desm. U.S. (1884), p. 133, t. 43, f. 16, 17.

Goniocystis (Trigonocystis) gracilis, Hass. Fr. Alg. (1845), p. 352.

Phycastrum gracile, Kutz. Spec. (1849), p. 181.

HAB. In ponds.

Lancashire, Westmoreland, Cornwall, Wales, Scotland; France, Germany, Sweden, Norway, Denmark, Italy, Hungary, Brazil, United States.

Plate LVIII., fig. 6. *a*, living frond; *b*, empty frond; *c d*, end views.

Staurastrum paradoxum. *Meyen. Nova Acta. Leop.* (1828), XIV., *p.* 43, *f.* 37, 38.

Frond rough; front view with elongated diverging processes, which are minutely trifid at the apex; end view quadrangular, or sometimes triangular.

SIZE. Length 72 μ; diam. 50 μ (D.); diam. 40-40 μ (K.); diam. 40-60 μ (Wo.).

Ralfs Ann. Nat. Hist. (1845), xv., t. 10, f. 2. Ralfs Desm. (1848), p. 138, t. 23, f. 8. Archer in Prit. Inf. (1861), p. 742. Delponte Desm. (1878), t. 11, f. 63-65. Notaris Desm. Ital. (1867), t. 4, f. 46. Kirchn. Alg. Schles. (1878), p. 167. Cleve Sver. Desm. (1864), p. 491. Lundell Desm. Suec. (1871), p. 68. Nordstedt Norges Desm. (1873), p. 34. Petit Liste Desm. Paris (1877), p. 31. Wittrock Scan. Desm. (1869), p. 18. Wood F. Water Algæ U.S. (1872), p. 152. Wille Norges Desm. (1880), p. 46. Schaarschm. Magy. Desm. (1883), p. 274. Brebisson Liste Desm. (1856), p. 139. Rabh. Alg. Eur. (1868), p. 210, in part. Jacobsen Desm. Denm. (1874), p. 207. Lemaire Desm. Vosg. (1883), p. 24. Wolle Desm. U.S. (1884), p. 129, t. 42, f. 36, 37.

Phycastrum paradoxum, Kutz. Phy. Germ. (1845), p. 138, t. 85, f. 3.

Goniocystis (Staurastrum) paradoxum, Hass. Fr. Alg. (1845), p. 354.

Micrasterias staurastrum, Kutz. Syn. Diat. (1833), p. 599.

HAB. In ponds.

Gloucester, Westmoreland, Sussex, Cornwall, Wales, Scotland; France, Germany, Sweden, Norway, Denmark, Italy, Hungary, United States.

Plate LIX., fig. 4. *a*, living frond; *b*, empty frond; *c d*, end views.

var. β. **longipes.** *Nordst. Norges Desm.* (1873), *p.* 35, *f.* 17.

More slender and spreading.

SIZE. With rays, 77 μ (N.).

Archer in Journ. Bot. (1874), iii., p. 92.

HAB. In pools.

Ireland; Norway.

Plate LIX., fig. 5. *a*, living frond; *b*, empty frond; *c d*, end views.

Staurastrum ophiura. *Lundell Desm. Suec.* (1871), *p.* 69, *t.* 4, *f.* 7.

Large, slightly emarginate at the middle; semi-cells obovate gradually dilated upwards, furnished at the convex apex with bifid papillæ, lower angles with a papilla, superior angles produced into elongated arms, which are slender, colourless, straight, or slightly incurved; margin delicately denticulate; semi-cells in end view 7 (rarely 6 or 8) rayed; rays very long, three-toothed at the apex, very gradually attenuated outwards; margin serrato-dentate; in the centre ornamented with a coronet of 7 (rarely 6 or 8) quadrifid papillæ.

SIZE. Length 65-82 μ; diam. 34-40 μ; rays 63 μ (L.); length 65-80 μ; diam. 140-150 μ, with rays (Wo.).

Archer Micr. Journ. xvii. (1877), p. 192; xiii. (1873), p. 311. Nordstedt Norges Desm. (1873), p. 35. Wille Norges Desm. (1880), p. 46. Wolle Desm. U.S. (1884), p. 134, t. 43, f. 10, 11.

HAB. In mountain pools.

Ireland; Sweden, Norway, United States.

Plate LIX., fig. 1. *a*, living frond; *b*, empty frond; *c d*, end views.

Staurastrum elongatum. *Barker in Micr. Journ.* IX. (1869), *p.* 424 (1871), *p.* 93.

Frond deeply constricted in the middle; segments T-shaped, longer than broad; ends crowned with a wreath of fine spines or granules, arms horizontal, each nearly half the length of the segment, and terminated by 3 or 4 minute spines; base of each segment inflated sphærically, and marked with 3 or 4 rows of small spines; end view three-rayed, tapering into elongate, straight, horizontal processes; rough, especially at the most concave parts, between arms, with minute spines.

SIZE. Length 61-77 μ; diam., with rays, 43-45 μ (N.); length 60-75 μ; diam. 43-45 μ (Wo.).

Wolle Desm. U.S. (1884), p. 130, t. 46, f. 11, 12.

Staurastrum terebrans, Nordstedt Norges Desm. (1873), p. 34, fig. 16. Archer in Journ. Bot. (1874), iii., p. 91.

HAB. In bog pools.

Connemara and County Cork (Ireland); Norway.

Plate LIX., fig. 2. *a*, living frond; *b*, empty frond; *c d*, end views.

Staurastrum cerastes. *Lundell Desm. Suec.* (1871), *p.* 69, *t.* 4, *f.* 6.

Rather large, a little broader than long, semi-cells lunate, but in the middle part sub-conical, ventricose, produced on each side into a robust, not very long, incurved horn, attenuated towards the rather obtuse extremity, external convex margin densely clad with numerous warts which are emarginate and bifid, about the apex of the horn entire and papillæform, interior margin (concave) naked, with a papillæ at the base; end view 3 or 4 angled, the angles produced into a straight, stout horn, attenuated from the broad base to the tridentate apex, at and within the margin densely ornamented with emarginate bifid warts, which are entire near the apex of the horn.

Size. Length 52-55 μ; diam. (with horns) 63-72 μ (L.); diam. 60-70 μ (Wo.).

Nordst. Norges Desm. (1873), p. 35. Archer in Journ. Bot. (1874), iii., 94. Micr. Journ. xii. (1872), p. 202. Wille Norges Desm. (1880), p. 46. Wolle Desm. U.S. (1884), p. 133, t. 43, f. 6, 7.

Hab. In mountain pools.

Ireland, North Wales; Sweden, Norway, United States.

Plate LIX., fig. 3. *a,* living frond; *b,* empty frond; *c,* end view.

††† *Segments furnished with variously disposed spines, simple or short and notched at the apex.*

Staurastrum proboscideum. *(Breb.) Archer in Pritch. Infus.* (1861), *p.* 742.

Segments in front view broadly cuneiform, ends somewhat convex, rough, with minute truncate spines, end view triradiate, sides concave.

Size. Length 45 μ; diam., with arms, 60 μ.

Jacobsen Desm. Denm. (1874), p. 206. Nordst. de Algis (1880), p. 10.

Staurastrum asperum, var. β *proboscideum*, Breb. in Ralfs Desm. (1848), p. 139, t. 23, f. 12, *b c.*

Hab. In pools.

Sussex, Gloucester, Cornwall; France, Denmark, Java.

Plate LIX., fig. 6. *a,* living frond; *b,* empty frond; *c d,* end views.

Staurastrum controversum. *Breb. in Meneg. Syn. Desm.* (1840), *p.* 228.

Frond spinulose; segments with a short process on each side terminated by minute spines; end view with three or four distorted rays. Zygospore orbicular, spiny; spines stout, once or twice bifid at the apex.

Size. Length 75 μ; diam. 38-65 μ (Wo.).

Ralfs Desm. (1848), p. 141, t. 23, f. 3. Archer in Prit. Inf. (1861), p. 742. Lundell Desm. Suec. (1871), p. 68. Nordstedt Norges Desm. (1873), p. 33. Brebisson Liste Desm. (1856), p. 138. Notaris Desm. Ital. (1867), p. 49, t. 4, f. 39. Wolle Desm. U.S. (1884), p. 143, t. 45, f. 24, 25. Rabh. Alg. Eur. (1868), p. 217. Jacobsen Desm. Denm. (1874), p. 207.

Staurastrum aculeatum, Ralfs Ann. Nat. Hist. (1845), xv., p. 156, t. 11, f. 4.

Goniocystis (*Trigonocystis ?*) *aculeatum*, Hass. Fr. Alg. (1845), p. 353.

Staurastrum aculeatum, var *b. controversum*, Rabh. Alg. Eur. (1868), p. 217. Wille Norges Desm. (1880), p. 44.

Hab. In ponds.

Surrey, Sussex, Gloucester, Westmoreland, Cornwall, Wales, Scotland; France, Sweden, Norway, Denmark, Italy, United States.

Plate LX., *fig.* 1. *a a*, living fronds; *b*, empty frond; *c d*, end views; *e*, zygospore.

Staurastrum aculeatum. *Meneg. Syn. Desm.* (1840), *p.* 226.

Frond spinulose; segments with a short process on each side terminated by minute spines; end view with three to five straight rays, terminated by spines. Zygospore globose, armed with long spines, forked or dichotomous at the apices.

Size. Length 45-48 μ; diam. 35 μ (N.). Length 36 μ; diam. 54 μ (D.). Diam. 34-50 μ (K.). Diam. without spines 50 μ (Wo.).

Ralfs Desm. (1848), p. 142, t. 23, f. 2. Kirchn. Alg. Schles. (1878), p. 166. Archer in Prit. Inf. (1861), p. 742. Delponte Desm. (1878), t. 13, f. 3-5. Cleve Sver. Desm. (1864), p. 490. Lundell Desm. Suec. (1871), p. 68. Nordstedt Norges Desm. (1873), p. 33. Petit Liste Desm. Paris (1877), p. 31. Brebisson Liste Desm. (1856), p. 138. Rabh. Alg. Eur. (1868), p. 217 in part. Wille Nov. Zem. (1879), p. 54. Wille Norges Desm., p. 44. Schaarschm. Magy. Desm. (1883), p. 274. Mask. New. Zeal. Desm. (1882), p. 244. Nordstedt Desm. Spitz. (1872), p. 40. Jacobsen Desm. Denm. (1874), p. 207 partly. Wolle Desm. U.S. (1884), p. 140, t. 45, f. 1-3.

Desmidium aculeatum, Ehr. Inf. (1838), p. 143, t. 10, f. 12.

Phycastrum aculeatum, Kutz. Phyc. Germ. (1845), p. 138.

Goniocystis (*Trigonocystis*) *aculeatum*, Hass. F. W. Alg. (1845), p. 353, t. 84, f. 12.

HAB. In ponds.

Sussex, Hants, Westmoreland, Wales; France, Germany, Sweden, Norway, Denmark, Nova Zembla, Italy, Hungary, United States, New Zealand.

Plate LX., fig. 2. *a*, living frond; *b*, empty frond; *c d*, end views.

Staurastrum vestitum. *Ralfs Desm.* (1848), *p.* 143, *t.* 23, *f.* 1.

Frond rough with minute emarginate spines; segments fusiform; end view triradiate, each side having two spines, short slender, and often accompanied by other smaller ones.

SIZE. Length 64 μ; diam. 43 μ (D.); length 41 μ; diam. 63-78 μ (K.); diam. 62-90 μ (Wo.).

Archer in Prit. Inf. (1861), p. 742, t. 3, f. 30, 31. Delponte Desm. (1878), t. 13, f. 46-49. Cleve Sver. Desm. (1864), p. 491. Lundell Desm. Suec. (1871), p. 68. Kirch. Alg. Schles. (1878), p. 167. Nordstedt Norges Desm. (1873), p. 34. Petit Liste Desm. Paris (1877), p. 31. Brebisson Liste Desm. (1856), p. 137. Rabh. Alg. Eur. (1868), p. 219 (sine var. b.). Jacobsen Desm. Denm. (1874), p. 207. Wille Norges Desm. (1880), p. 46. Lemaire Desm. Vosg. (1883), p. 24. Nordst. Desm. Bras. (1869), p. 230. Wolle Desm. U.S. (1884), p. 138, t. 45, f. 28-30.

HAB. In ponds, &c.

Sussex, Lake District, Wales; France, Germany, Sweden, Norway, Denmark, Italy, Brazil, United States.

Plate LX., fig. 3. *a*, living frond; *b*, empty frond; *c d*, end views.

Staurastrum oxyacanthum. *Archer in Pritch. Infus.* (1861), *p.* 742.

Segments in front view broadly fusiform, rough with minute granules, furnished on the outer margin with six subulate acute depressed spines (four of which are apparent in this view), processes elongate incurved, the granules thereon arranged in transverse lines terminated by 3 or 4 minute spines; end view triradiate, the processes elongate, straight sides somewhat concave, end furnished at the middle with a pair of very slender extremely acute subulate spines projecting to each side.

SIZE. Length 29 μ; diam. 40 μ (L.).

Lundell Desm. Suec. (1871), p. 67. Rabh. Krypt. Fl. Sachs. (1863), p. 193. Rabh. Alg. Eur. (1868), p. 219. Nordst. Desm. Grönl. (1885), p. 11.

HAB. In pools.

Lake District; Sweden, Greenland, Germany.

Plate LX., fig. 4. *a*, living frond; *b*, empty frond; *c d*, end views.

Staurastrum Sebaldi. *Reinsch. Algenflora, p.* 175, *t.* XI., *f.* 1.

Semi-cells in front view truncately obconic, exterior angles gradually narrowed, and a little produced into shortly truncate 3-4 dentate arms, dorsal margin convex, lateral margins and dorsal margin downwards to half the segment armed with spines, lateral arms marked with parallel transverse series of warts; end view triangular, sides angularly concave, narrowed into the short, truncate 3-dentate arms, which are rough with warts in parallel lines, on and within the sides two parallel rows of spines.

SIZE. Length 76 μ; diam. 69-76 μ (Re.); diam. 75-95 μ (Wo.).

Lundell Desm. Suec. (1871), p. 68.

var. β **ornatum.** *Nordstedt Norges. Desm.* (1873), *p.* 33, *fig.* 15.

Arms more slender and elongated.

SIZE. Length 81 μ; diam. (with arms) 132 μ (N.).

Wolle Desm. U.S. (1884), p. 138, t. 46, f. 1-6, 10.

HAB. In pools.

North Wales, Ireland; Germany, Sweden, Norway, United States.

Plate LXI., fig. 1. *a*, living frond; *b* empty frond; *c d*, end views.

Staurastrum anatinum. *Cke. & Wills Grevillea* (1880), ., *p.* 92, *t.* 139, *f.* 6.

Large, granularly rough or spinous; semi-cells in front view oval, with ends drawn out into diverging arms, apices trifid; end view triangular, sides slightly concave, with angles produced into straight arms; margins in both views ornate with large, emarginate bifid, or papillæform warts.

SIZE. Length 30-40 μ; diam. 60-80 μ (W.); length 50 μ; diam., including arms, 100 μ; isthmus 20 μ; length of arms 25 μ (C. & W.).

Cooke in Journ. Quekett Micr. Club (1880), vi., t. 15, f. 12, 13. Wolle Desm. U.S. (1884), p. 139, t. 51, f. 1, 2.

HAB. In mountain pools.

North Wales; United States.

Plate LXI., fig 2. *a*, living frond; *b*, empty frond; *c d*, end views.

X. Segments in front view with the opposite lateral extremities terminating in one or two elongate colourless processes mostly divided at the apex, and in end view either tapering into a simple process at each angle, and furnished with others between or above of a similar character, definite in number, or the angles furnished with two short processes, side by side, and unaccompanied by others.

† *Segments at end view with the additional processes, more than one for each angle, and placed on the margin, or upper surface, and diverging laterally.*

Staurastrum eustephanum. (*Ehr.*) *Ralfs. Desm.* (1848), *p.* 215.

Of nearly equal length and breadth, granular, margins more or less serrate, semi-cells elliptic, with angles produced, furcate; end view triangular, furnished with nine processes, counting the three somewhat produced and bifurcate angles, the other six on the upper surface, attached, usually, between the centre and the margins, ends elevated above the surface, the processes extend to margins, or slightly over them; in front view, these present themselves on the outer margin in two pairs; the third pair is either under the cell, or stands towards the eye, and is invisible.

SIZE. Diam. 50·75 μ (Wo.).

Rabh. Alg. Eur. iii. (1868), p. 220. Mask. New Zeal. Desm. (1882), p. 244, f. 11. Wolle Desm. U.S. (1884), p. 147, t. 48, f. 9-11.

Staurastrum pseudofurcigerum, Cooke in Journ. Quekett Micr. Club (1880), vi., p. 210, t. 14, f. 1-3.

Desmidium eustephanum, Ehr. Verbr. (1843), p. 124, t. iv., f. 23?

Stephanoxanthium eustephanum, Kutz. Spec. (1849), p. 184.

HAB. In pools.

North Wales; Germany, New Zealand, United States.

Plate LXII., fig. 2. *a,* living frond; *b* empty frond; *c d e,* end views.

†† *Segments with the additional processes, one for each angle, and placed on the upper surface immediately above those terminating the angles.*

Staurastrum verticillatum. *Archer in Micr. Journ.* (1869), *p.* 196.

The largest of the rayed or armed forms yet found in Europe. Ten radiating arms, which are beautifully toothed or serrated, and notched at the end, extend in the end view like a wheel.

Size. Diam., including arms, 127 μ (A.).

Hab. In pools.

Ireland.

Plate LXI., fig 3. *a b*, end views.

This species has never been fully and properly described, in common with many others of Mr. Archer's species.

Staurastrum furcigerum. *Bréb. in Meneg. Syn. Desm.* (1840), *p.* 226.

Segments granular, separated by a deep constriction, terminating on each side in two stout bifid processes, end view with three or four angles each terminating in a process, sides concave at the centre.

Size. Length 72 μ; diam. 72 μ (D.); length 77-83 μ; diam. 90 μ (K.); diam. 50-62 μ (Wo.).

Brebisson Liste Desm. (1856), p. 136. Archer in Prit. Inf. (1861), p. 743, t. 3, f. 32-33. Cleve Sver. Desm. (1864), p. 490. Lundell Desm. Suec. (1871), p. 70. Wolle Desm. U.S. (1884), p. 146, t. 48, f. 12-14, t. 52, f. 23, 24. Nordstedt Norges Desm. (1873), p. 36. Petit Liste Desm. Paris (1877), 31. Wittrock Scan. Desm. (1869), p. 18. Wittr. Sottv. Alg., p. 50. Wood F. Water Algæ U.S. (1872), p. 154. Rabh. Alg. Eur. (1868), p. 219, in part. Wille Norges Desm. (1880), p. 47. Kirch. Alg. Schles. (1878), p. 167. Lemaire Desm. Vosg. (1883), p. 24. Jacobsen Desm. Denm. (1874), p. 209.

Didymocladon furcigerum, Ralfs Desm. (1848), p. 144, t. 33, f. 12. Delponte Desm. (1878), p. 78, t. 14, f. 24-27. Schaarschm. Magy. Desm. (1883), p. 274.

Asteroxanthium furcigerum, Kutz. Sp. Alg. (1849), p. 183.

Xanthidium coronatum, Ehr. Mikr. Leb. in Amer., p. 138, t. 4, f. 26.

Asteroxanthium coronatum, Kutz. Sp. Alg. (1849), p. 183.

Phycastrum furcigerum, Kutz. Phy. Germ. (1845), p. 138.

Hab. In pools.

Cheshire, Lancashire, Westmoreland, Sussex, Hants, Wales, Cornwall; France, Germany, Sweden, Norway, Denmark, Italy, Hungary, United States.

Plate LXII., fig. 1. *a*, living frond; *b c*, empty fronds; *d e f*, end views.

Staurastrum sexangulare. *Buln. in Hedw.* (1863), II., *p.* 501, *t.* IX. A, *fig.* 1.

Middle size or larger, constricted with a broad acute-angled sinus, semi-cells more or less depressedly globose, dorsal margin truncate, ventral convex, lateral processes in pairs (rarely three), divergent, deeply cut, broadly protracted, processes elongated, colourless, margin delicately 3-4 toothed, apice 3-4-fid, end view 4 to 7 sided, angles a little protracted, elongated into two (rarely three) rays, margin denticulate, ends 3-4-fid, deeply incised, inner angles retuse, ornamented with a row of granules within the margin.

Size. Length 44-60 μ, with rays 100 μ; diam. 28-43, with rays 90-116 μ; longest rays 32 μ (L.), 100 × 45-54 μ (C.)

Archer Micr. Journ. xvii. (1877), p. 192. Lundell Desm. Suec. (1871), p. 71, t. 4, f. 9. Nordstedt Norges Desm. (1873), p. 66. Wille Norges Desm. (1880), p. 47. Nordst. de Algis (1880), p. 11.

Didymocladon sexangularis, Bulnheim in Hedwigia (1863) II., p. 51, t. ix. A, f. 1.

Staurastrum furcigerum, Rabh. Alg. Eur. (1868), p. 219, in part.

Hab. In mountain pools.

Germany, Sweden, Norway, Java.

Plate LXII., fig. 3. *a a*, living fronds; *b*, empty frond; *c d*, end views. *Plate LXIV., fig.* 4. *a b*, end views.

Staurastrum artiscon (*Ehr.*). *Lundell Desm. Suec.* (1871), *p.* 40.

Segments narrowed at the base, separated by a deep constriction, spines numerous, restricted to the outer margin, stout, terminated by three or four diverging points, end view nine-sided, angles extending in straight radiating processes, with six similar shorter processes in the middle, membrane delicately punctate.

Size. Length, with processes, 130 μ; diam., with processes, 130 μ; processes 40-44 μ (L.); diam. 100-120 μ (Wo.).

Archer Micr. Journ. xvii. (1877), p. 192. Lundell Desm. Suec. (1871), p. 70, t. 4, f. 8. Nordstedt Norges Desm (1873), p. 36. Wille Norges Desm. (1880), p. 46. Wolle Desm. U.S. (1884), p. 148, t. 47, f. 9, 10.

Xanthidium (?) artiscon, Archer in Prit. Inf. (1861), p. 736. Wood F. Water Algæ U.S. (1872), p. 156. Rabh. Alg. Eur. (1868), p. 224.

Asteroxanthium artiscon, Kutz. Spec. (1849), p. 184.

Hab. In pools.

Ireland; Germany, Sweden, Norway, United States.

Plate LXIII., fig. 1. *a*, living frond; *b c*, empty fronds; *d e*, end views.

††† *Segments with two processes from each angle, placed side by side.*

Staurastrum læve. *Ralfs Desm.* (1848), *p.* 131, *t.* 23, *f.* 10.

Frond smooth; segments with short processes at the apex, and directed outwards; end view with three or four bipartite angles.

SIZE. Length 22 μ; diam. 13 μ (K.).

Wittr. Sottv. Alg. (1872), p. 54. Archer in Prit. Inf. (1861), p. 744. Cleve Sver. Desm. (1864), p. 490. Lundell Desm. Succ. (1871), p. 63. Nordstedt Norges Desm. (1873), p. 28. Brebisson Liste Desm. (1856), p. 137. Rabh. Alg. Eur. (1868), p. 206. Jacobsen Desm. Denm. (1874), p. 208. Nordst. Desm. Bras. (1869), p. 226. Kirchn. Alg. Schles. (1878), p. 167.

HAB. In pools.

Wales, Lake District; France, Germany, Sweden, Norway, Denmark, Brazil, United States.

Plate LXIII., fig. 2. *a*, living frond.

var. **Clevei.** *Wittrock Scan. Desm.* (1869), *p.* 18, *fig.* 9.

Segments 6-rayed, rays long, spreading, furcate.

SIZE. Length with rays 53 μ; diam. 50 μ (W.).

Archer in Micr. Journ. (1871), pp. 92. Lundell Desm. Succ. (1871), p. 62. Nordstedt Norges Desm. (1873), p. 28.

HAB. In pools.

Sweden, Norway.

Plate LXIII., fig. 3. *a*, living frond.

XI. Segments in front view with each opposite lateral extremity terminating in a colourless process, either short, rounded and dentate, or elongate and entire at the end, end view circular, margined with from 5 to 7 processes, or compressed, and with but two processes.

† *End view circular.*

Staurastrum sexcostatum. *Breb. in Meneg. Syn. Desm.* (1840), *p.* 228.

Segments in front view with a toothed angle at each side; end view circular with five or six broad, short, toothed lobes.

SIZE. Length 36-46 μ; diam. 26-41 μ (K.).

Ralfs Desm. (1848), p. 129, t. 23, f. 5. Archer in Prit. Inf. (1861), p. 744. Nordstedt Desm. Arct. (1875), p. 36.

Cleve Sver. Desm. (1864), p. 491. Lundell Desm. Suec. (1871), p. 74. Nordstedt Norges Desm. (1873), p. 37. Petit Liste Desm. Paris (1877), p. 31. Brebisson Liste Desm. (1856), p. 138. Rabh. Alg. Eur. (1868), p. 216. Wille Norges Desm. (1880), p. 47. Kirchn. Alg. Schles. (1878), p. 165.

Goniocystis (Pentasterias) Jenneri, Hass. Fr. Alg. (1845), p. 356.

Stephanoxanthium sexcostatum, Kutz. Spec. (1849), p. 184.

Staurastrum Jenneri, Ralfs Ann. Nat. Hist. (1845), xv., p. 158, t. 11, f. 8.

HAB. In ponds.

Sussex, Gloucestershire, Wales, Cornwall; France, Germany, Sweden, Norway, Spitzbergen.

Plate LXIV., fig. 1. *a c,* living fronds; *b d,* empty fronds; *e f,* end views.

Staurastrum margaritaceum. *Meneg. Syn. Desm.* (1840), *p.* 227.

Segments rough; tapering at the constriction, and having short, lateral processes; end view with five or more short, narrow, obtuse rays.

SIZE. Diam. 33-44 μ (K.); diam. 30-35 μ (Wo.).

Ralfs Ann. Nat. Hist. (1845), xv., p. 157, t. 11, f. 7. Ralfs Desm. (1848), p. 134, t. 21, f. 9. Archer in Prit. Inf. (1861), p. 744, t. 3, f. 34, 35. Nordstedt Desm. Arct. (1875), p. 33. Wille Norges Desm. (1880), p. 41. Cleve Sver. Desm. (1864), p. 491. Nordst. Desm. Bras. (1869), p. 226. Nordstedt Norges Desm. (1873), p. 28. Notaris Desm. Ital. (1867), p. 53, t. 5, f. 48. Wood F. Water Algæ U.S. (1872), p. 150. Kirch. Alg. Schles. (1878), p. 166. Brebisson Liste Desm. (1856), p. 140. Rabh. Alg. Eur. (1868), p. 206. Jacobsen Desm. Denm. (1874), p. 206. Lemaire Desm. Vosg. (1883), p. 23. Wolle Desm. U.S. (1884), p. 125, t. 41, f. 31-35.

Pentasterias margaritacea, Ehr. Inf. (1838), p. 144, t. 10, f. 15.

Phycastrum margaritaceum, Kutz. Phy. Germ. (1845), p. 138.

Goniocystis (Pentasterias) margaritacea, Hass. Fr. Alg. (1845), p. 356.

Phycastrum rotundatum, Kutz. Spec. (1849), p. 182.

HAB. In ponds.

Sussex, Cornwall, Somersetshire, Westmoreland, Wales, Scotland; France, Germany, Sweden, Norway, Denmark, Spitzbergen, Italy, Brazil, United States, Java.

Plate LXIV., fig. 2. *a,* living frond; *b,* empty frond; *g h i,* end views; *c,* living frond of variety; *d,* empty frond; *e f,* end views.

Staurastrum arachne. *Ralfs Ann. Nat. Hist.* (1845), xv., *p.* 157, *t.* 11, *f.* 6.

Segments rough with minute granules suborbicular, with elongated, slender incurved processes; end view with five linear rays.

Size. Diam. 40 μ; arms 14 μ (K.); diam. 40-50 μ (Wo.).

Ralfs Desm. (1848), p. 136, t. 23, f. 6. Archer in Prit. Inf. (1861), p. 744. Kirch. Alg. Schles. (1878), p. 168. Lundell Desm. Suec. (1871), p. 69. Nordstedt Norges Desm. (1873), p. 35. Wood F. Water Algæ U.S. (1872), p. 152. Brebisson Liste Desm. (1856), p. 139. Rabh. Alg. Eur. (1868), p. 210. Jacobsen Desm. Denm. (1874), p. 208, in part. Wolle Desm. U.S. (1884), p. 129, t. 42, f. 38-42.

Goniocystis (*Pentasterias*) *arachnis*, Hass. Fr. Alg. (1845), p. 355.

Phycastrum arachne, Kutz. Spec. Alg. (1849), p. 181.

Phycastrum radiatum, Kutz? Spec. Alg. (1849), p. 181.

Hab. In ponds.

Wales, Scotland; France, Germany, Sweden, Norway, Denmark, United States.

Plate LXIII., *fig.* 4. *a a*, living fronds; *b b*, empty fronds; *c d*, end views.

†† *End view compressed.*

Staurastrum tetracerum. *Ralfs Ann. Nat. Hist.* (1845), xv., *p.* 150, *t.* 10.

Frond rough; front view with four slender diverging processes, which are entire at the apex; end view compressed, with a process at each extremity.

Size. Length 14 μ; diam. 14 μ (D.); diam., with arms, 22-47 μ. Zygospore 16 μ; with spines 30 μ (K.).

Ralfs Desm. (1848), p. 137, t. 23, f. 7. Archer in Prit. Inf. (1861), p. 744. Wille Norges Desm., p. 46. Delponte Desm. (1878), t. xi., f. 25-28. Cleve Sver. Desm. (1864), p. 491. Lundell Desm. Suec. (1871), p. 68. Nordstedt Norges Desm. (1873), p. 35. Kirch. Alg. Schles. (1878), p. 168. Petit Liste Desm. Paris (1877), p. 31. Brebisson Liste Desm. (1856), p. 139. Schaarschm. Magy. Desm. (1883), p. 274. Wittrock Scan. Desm. (1869), p. 18. Lemaire Desm. Vosg. (1883), p. 24. Nordst. Desm. Bras. (1869), p. 228.

Staurastrum paradoxum b. tetracerum, Rabh. Alg. Eur. (1868), p. 210.

Micrasterias tetracera, Kutz. Syn. Diat. (1833), p. 602, f. 83, 84.

Micrasterias tricera, Kutz. Syn. Diat. (1833), p. 602, f. 85.

Staurastrum arachne var. *tetracera*, Jacobsen Desm. Denm. (1874), p. 208.

Staurastrum paradoxum, Ehr. Inf. (1838), p. 143, t. 10, f. 14.

Goniocystis (Staurastrum?) tetracerum, Hass. Fr. Alg. (1845), p. 354, t. 85, f. 4.

Phycastrum paradoxum, Kutz. Sp. Alg. (1849), p. 180.

Hab. In ponds.

Sussex, Westmoreland, Gloucestershire, Cornwall, Wales, Scotland; France, Germany, Sweden, Norway, Denmark, Italy, Hungary, Brazil.

Plate LXIII., fig. 5. *a a*, living fronds; *b b*, empty fronds; *c d*, end views.

Doubtful species.

Staurastrum enorme. *Ralfs Desm.* (1848), *p.* 140, *t.* 33, *f.* 11.

Frond irregular or quadrate, spinous; end view three or four lobed; lobes broad, more or less emarginate or bifid, and terminated by spines which are either simple or branched.

Size. Diam. 25-40 μ.

Wolle Desm. U.S. (1884), p. 151, t. 41, f. 19-25.

Hab. In ponds.

North Wales; United States.

Some of the forms belong to *Polyedrium enorme* (see Fresh Water Algæ, p. 32), perhaps others may belong here.

Plate LXIV., fig. 3. *a c e*, living fronds; *b d f*, empty fronds; *g h i*, end views.

NOTE ON THE PLATES.

All the figures are drawn uniformly by camera lucida to 400 diameters, except in a few instances where otherwise indicated. The greater part of the figures have been drawn direct from the specimens themselves; in a few cases, where specimens were not available, copies have been made of published figures, as indicated in the plate description at the end of each species. Copy of "scale" for measurement is given on the last plate.

APPENDIX.

The following species have come to our knowledge, as British, during the progress of the present work through the press:—

GEN. 1, *bis.* **GENICULARIA.** *De Bary* (1858).

Filament cylindrical; joints elongate cylindrical, without a constriction or inflation, ends truncate; endochrome arranged in two or three spiral bands upon the cell wall, sometimes irregular. Joints previous to conjugation disunited, and bent during the process; zygospore placed between the empty conjugated joints.—*Pritch. Infus.*, p. 721.

Genicularia spirotænia. *De Bary Conjug.* (1858), *p.* 77, *t.* IV., *f.* 1-22.

Joints ten to twenty times as long as broad, very slightly enlarged towards their ends, on the outer surface rough with minute scattered granules. Zygospore orbicular, smooth, placed between the conjugating joints, which are bent into a knee shape, with which it remains for some time in connexion.

SIZE. Length 200 to 400 μ; diam. 20 μ.

Rabh. Alg. Eur. iii. (1868), p. 156. Pritch. Infus. (1861), p. 721, t. 3, f. 3.

Gonatozygon spirotænium, De Bary Hedwigia i., p. 106.

HAB. In bogs.

Cornwall; Germany.

Plate LXVI., fig. 6. *a b*, living cells; *c*, zygospore. After De Bary.

Docidium granulatum. *Bennett in Journ. Roy. Micr. Soc.* (1887), *p.* 15, *fig.* 17.

Frond minute, about five times as long as broad, slightly constricted in the middle, conspicuously covered with pearly granules. Endochrome dark green, with a light transverse band in the centre. *Bennett Alg. Cornw.* p. 15.

Size. Length 50 μ; diam. 10 μ (B.).

Hab. In bog pools.

Cornwall.

"About the size of *D. minutum*. Nearest to *D. asperum*, Ralfs, from which it differs in its dimensions, in the central constriction, and in the ends not being dilated."—*Bennett.*

Plate LXV., fig. 2. *a*, living frond; *b*, empty frond. After Bennett.

Closterium eboracense. *Turner.*

For description see page 37.

Plate LXV., fig. 1. *a*, living frond; *b*, empty frond. After drawing by W. B. Turner.

Penium rufopellitum. *Roy in Journ. Dubl. Micr. Club*, IV. (1880-5), *p.* 38.

"It most resembles *Penium cylindrus*, but is very distinct indeed. This form is of a brownish-red colour, due to an external roughish bark-like coating, which is occasionally shed from a portion of the superficies, the bare portion of the wall being then seen to be colourless. There does not seem to be any other species with this curious characteristic; the reddish colour and roughish granular superficies belonging to *P. cylindrus* do not appear to be due to an outward coating capable of exfoliation."

Size. Not stated.

Hab. In pools.

Near Aberdeen; Connemara.

Spirotænia acuta. *Hilse in Rabh. Alg. Eur.* III., 148.

Frond fusiform, acuminate from the tumid middle, 5-8 times longer than broad, chlorophyll bands numerous, narrow, densely twisted.

Size. Diam. 6-7½ μ (K.).

Archer in Journ. Dubl. Micr. Club iv. (1880-5), p. 42. Rabh. Alg. Exs., No. 1830. Kirch. Alg. Schles. (1878), p. 137.

Hab. In bogs.

England, Ireland, Germany.

Plate LXVI., fig. 5. Empty fronds. From preserved specimens; endochrome too diffused to determine. Mr. Archer is of opinion that the bands are too indefinite for this genus.

Micrasterias apiculata (*Ehr.*). *Meneg. Syn. Desm.* (1840), 216.

Frond orbicular, hispid all over with scattered spines; segments 5-lobed; basal and middle lobes once or twice incised, their external margin toothed, ultimate subdivisions furnished with two acute spines; end lobe narrow, spinous on external margin.

Size. Length 180-230 μ; diam. 200 μ (K.); diam. 188 μ (Kutz.); diam. 190 μ (Rab.); length 220 μ; diam. 180 μ (R. & B.); length 235-260 μ; diam. 201-227 μ (T.); length 216 μ; diam. 194 μ (D.).

Kutz. Spec. Alg. (1849), p. 170. Breb. Liste (1856), p. 120. Cleve Bidrag (1863), p. 486. Archer Pritch. Infus. (1861), p. 727. Rabh. Alg. Eur. (1868), iii., p. 193. Lund. Desm. Suec. (1871), p. 13. Jacobsen Desm. Denm. (1875), p. 188. Kirchn. Alg. Schles (1878), p. 163. Raciborski Desm. Krak. (1884), p. 22. Elfving Finska Desm. (1881), p. 6. Roy and Bisset Journ. Bot. (1886), p. 193, t. 269, f. 13. Joshua Linn. Journ. (1886), p. 326, t. 22, f. 13. Wolle Bull. Torr. Club (1886), p. 59. Delponte Desm. Ital. (1873), p. 77, t. v, f. 1-4. Raciborski Desm. Polon. (1885), p. 40, t. v, f. 1.

Euastrum apiculatum, Ehr. Abh. der Berl. Akad. (1833), p. 245. Ehr. Infus., p. 167, t. xii, f. 2 (as *E. aculeatum*), Kutz. Phyc. Germ. (1845).

Euastrum spinuligerum, Breb. sec. Kutz.

Didymidium (Micras.) apiculatum, Reinsch. Alg. Fl. (1867), p. 145.

Micrasterias fimbriata, v. ornata, Buln. Hedw. (1859), p. 21, t. 2, f. 3.

Hab. In pools.

Westmoreland; France, Germany, Denmark, Sweden, Finland, Poland, Italy, India, Burma, Japan, United States.

Plate XLVIII., fig. 1. *a*, living frond; *b*, empty frond. After W. B. Turner.

Euastrum Armstrongianum. *Archer in Journ. Dubl. Micr. Club* IV. (1880-5), *p.* 25.

This, in common with others of Mr. Archer's species, has been announced, but not described. He says only "It is an exceedingly well-marked and distinct form. It occurs in deep and limpid water, the ponds being such as are kept constantly at a maximum degree of fulness from a bottom spring."

Size. Not stated.

Hab. In ponds.

Connemara.

Euastrum crenulatum. *Bennett in Journ Roy. Micr. Soc.* (1887), *p.* 17, *figs.* 20-21.

Frond very minute. Semi-cells broadest at the apex, with two teeth at each outer angle and one at the base; sides concave; apical edge with three concave crenations, of which the centre one is the largest, sinus broad. Each semi-cell with three prominent protuberances. *Bennett Alg. Cornw.* p. 17.

SIZE. Length 25 μ; diam. 11 μ; isthmus 7 μ (B.).

HAB. In bog pools.

Cornwall.

Plate LXV., fig. 3. *a*, living frond; *b*, empty frond; *c*, end view; all magnified 600 diameters. After Bennett.

Euastrum oblongum, var. **integrum.** *Bennett in Journ. Roy. Micr. Soc.* (1887), *p.* 16, *fig.* 18.

Plate LXVI., fig. 1. *a*, living frond; *b*, empty frond; × 400. After Bennett.

Euastrum crassum, var. **cornubiense.** *Bennett in Journ. Roy. Micr. Soc.* (1887), *p.* 16, *fig.* 19.

Plate LXV., fig. 4. *a*, living frond; *b*, empty frond; × 400. After Bennett.

Cosmarium Wrightianum. *Archer in Journ. Dubl. Micr. Club* IV. (1880-5), *p* 19.

Minute, smooth, semi-cells oblongo-elliptic, ends somewhat retuse; but this feature is so slight as to be very readily overlooked. Zygospore tetrahedral, the angles bluntly rounded.

SIZE. Not stated.

HAB.

Ireland; not uncommon.

Cosmarium platyisthmum. *Archer in Journ. Dubl. Micr. Club* IV. (1880-5), *p.* 27.

Minute. In general outline in front, or broad view, much resembling, say, a section of a double railway rail, that is to say, the isthmus very broad, and comparatively long, thus the isthmus makes up a great proportion of the whole *Cosmarium*; the semi-cells are elliptic, much broader than high, the whole smooth; end view elongate-compressed, extremities rounded. The lateral extremities of the semi-cells somewhat taper ere becoming rounded off, and the upper margins are notably retuse at the middle.

SIZE. Not given.

HAB.

Ireland.

Cosmarium melanosporum. *Archer in Journ. Dubl. Micr. Club* IV. (1880-5), *p.* 34.

This little smooth *Cosmarium*, with its round, very darkly-tinted zygospore, has not been more minutely described. It is said to conjugate frequently, and always freely, so that when met with a large gathering may thus sometimes be made.

SIZE. Not stated.

HAB.

Ireland.

Cosmarium cymatopleurum. *Nordst. Desm. Spetz.* (1872), *p.* 28, *t.* 6, *f.* 4.

Large, one-third longer than broad, deeply constricted with a narrow linear sinus, broad outwards, semi-cells trapezoid, narrowed upwards from a sub-reniform base, sides nearly straight, slightly undulated, dorsal margin rounded-truncate, lower angles rounded; end view oval, with transverse granulate folds about each pole; side view elliptically-orbicular. Membrane thick, punctate.

SIZE. Length 85-92 μ; diam. 64 μ (N.); length 82-86 μ; diam. 60-70 μ (N.).

Wille Nova Sembla (1879), p. 36. Nord. & Wittr. Desm. Ital. (1876), p. 30. Nord. Desm. Arct. (1875), p. 18. Archer Proc. Dubl. Micr. Club, Vol. iv., p. 1, pp. 28, 31.

HAB. In pools.

Deeside; Spitzbergen, Nova Zembla, Italy.

Plate LXVI., fig. 3. *a*, living frond; *b*, empty frond; *c*, end view; *d*, side view; × 400. After Nordstedt.

Cosmarium discretum. *Bennett in Journ. Roy. Micr. Soc.* (1887), *p.* 17, *fig.* 23.

Frond small. Semi-cells nearly semi-elliptical, or slightly reniform, rough with pearly granules. Isthmus very conspicuous, separating the two frustules widely from each other, quite colourless. Cell-membrane punctate, and with five distinct protuberances in each semi-cell.

SIZE. Length 37½ μ; diam. 17½ μ (B.).

HAB. In bog pools.

Cornwall.

Plate LXVI., fig. 2. *a*, living frond; *b*, empty frond; × 400. After Bennett.

Cosmarium sphæricum. *Bennett in Journ. Roy. Micr. Soc.* (1887), *p.* 17, *fig.* 22.

Frond moderately large. Semi-cells very nearly sphærical, covered with very prominent projections, which give them a very deeply crenulated edge; sinus rather deep. Endochrome very dark green.

SIZE. Length 45 μ; diam. 45 μ (B.).

HAB. In bog pools.

Cornwall.

Plate LXV., fig. 5. *a*, living frond; *b*, empty frond; × 400. After Bennett.

Xanthidium concinnum. *Archer in Journ. Dubl. Micr. Clu* (1880-5), *p.* 32.

Very minute (about the size of *Cosmarium tinctum*), semicells elliptico-hexagonal, the apices bearing at each side, and at the upper very obtuse angles, a minute but very appreciable mucro, each front surface of each semi-cell showing a distinct median papilla; end view compressed, showing at middle on each side the very distinct, now prominent papilla.

SIZE. About 10-15 μ diam.

HAB.

Ireland.

Staurastrum turgescens, *de Not. Desm. Ital.* (1867), *p.* 51, *t.* IV., *fig.* 43.

Medium size, resembling *S. muricatum*. Segments in end view triangular, with very obtuse angles, broadly concave at the sides, in front view rounded-reniform, with a narrow isthmus. Cell membrane covered with numerous prominent papillæ.

SIZE. Length 40 μ; diam. 30 μ (N.).

Archer in Journ. Dubl. Micr. Club, iv. (1880-5), p. 17.

HAB. In ponds.

Ireland, Italy.

Plate LXVI., fig. 4. *a*, living frond; *b*, empty frond; *c*, end view; × 400.

Staurastrum, *Sp.* *Archer in Journ. Dubl. Micr. Club,* IV. (1880-5), *p.* 7.

Resembling *S. turgescens*, de Not., but less plump and rounded; zygospore orbicular, beset with slender spines, slightly dilated at the base, and minutely bi- or trifid at the apex, and green in colour.

SIZE. Not stated.

HAB.

Ireland.

Staurastrum cornutum. *Archer in Journ. Dubl. Micr. Club,* IV. (1880-5), *p.* 16.

Minute, "resembling *S. maamense*, plus horns, these slender, sometimes furcate, and more or less dissimilar, the crenatures on the margins of the semi-cells smaller, and less pronounced;" beyond the above "Mr. Archer would defer a description."

SIZE. Not stated.

HAB.

Connemara.

Staurastrum mesoleium. *Archer in Journ. Dubl. Micr. Club,* IV. (1880-5), *p.* 43.

About medium-sized, triangular in end view, in front view the angles a little produced, slightly spinulose. Resembling *St. oligacanthum*, Nordstedt (but not of Brebisson), since proposed to be called *St. mediolæve*, Nord.

SIZE. Not stated.

HAB.

Callery Bog, Connemara, (Scorston Moor, N.B. ?)

Staurastrum cornubiense. *Bennett in Journ. Roy. Micr. Soc.* (1887), *p.* 18, *fig.* 24.

Frond minute. Each semi-cell elliptical, but with the lower edge flatter than the upper rounded edge, 2-3 dentate at the base, and with a bifurcate colourless process on the shoulder. In front of each frustule is a large ovate protuberance, much deeper green than the rest of the frond, ending in two bifurcate horns. *Bennett Alg. Cornw.* p. 18.

SIZE. Length 35 μ; diam. 28 μ; protuberance 14 μ long, including horns, $7\frac{1}{2}$ μ broad (B.).

HAB. In bog pools.

Cornwall.

Plate LXV., fig. 6. *a*, living frond; × 400; *b*, empty frond; × 800. After Bennett.

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2191

INDEX.

PAGE
APTOGONUM.
diagonum. Delp. 12
desmidium. Ralfs. 12
Arthrodesmus. *Ehr*. . . . 134
bifidus. *Breb*. 137
convergens. *Ehr*. 136
cylindricus. Ehr. 10
incus, *Hass*. 135
,, v. divergens. *A*. . 136
,, v. convergens. *A*. 136
octocornis. *Ehr*. 134
,, v. simplex. *R*. 135
,, v. major. *R*. . 135
tenuissimus. *Ar*. 137
ASTEROXANTHIUM.
artiscon. Kutz. . .
coronatum. Kutz. .
furcatum. Kutz. .
furcigerum. Kutz. .
ramosum. Kutz. . .
BACILLARIA.
lunula. Schr. . . . .
Bambusina. *Kutz*. . . . 8
Brebissonii. *Kutz*. 9
Borreri. Delp. 9
BINATELLA.
aculeata. Breb. . . . 131
cuspidatum. Breb. . . 141
hispida. Breb. 149
muticum. Breb. . . . 156
muricata. Breb. . . . 159
tumida. Breb. 166
tricornis. Breb. . . . 168
Calocylindrus. *D. By*. . . 122
annulatus. *D. By*. . . . 122
attenuatus. (*Breb.*) . . 127
connatus. *Kirchn*. . . . 124
cucurbita. *D. By*. . . . 125
curtus. *D. By*. . . . 126
cylindricus. (*Ralfs.*) . . 122
cylindrus. Kirch. . . . 39
De Baryi. (*Ar.*). . . . 128
oblongus. (*Benn.*) . . 123

CALOCYLINDRUS—(*cont.*) PAGE
palaugula. *D. By*. . . 125
pseudarctoum. *N. & W*. 129
pseudo-connatus. *Nord*. 124
Ralfsii. Kirch. 122
strangulatus. *C. & W*. . 128
Thwaitesii. (*Ralfs.*) . . 126
tuberculatus. (*Ar.*) . . 123
turgidus. *Kirch*. . . . 127
Closterium. *N*. 17
acerosum, *Ehr*. 20
,, v. *lanceolatum*. K. 21
aciculare. *West*. . . . 36
acuminatum. Kutz. . . 26
acus. Nits. 33
acutum. *Breb*. 35

Brebissonii. Men. . . . 48
calosporum. *Wittr*. . . 27
candianum. Delp. . . . 32
caudatum. Corda. . . . 33
cornu. *Ehr*. 35
costatum. *Corda*. . . . 23
crenulatum. Ehr. . . . 15
cucumis. Wolle. . . . 37
cylindrus. Ehr. . . . 39
cynthia. *Not*. 26
Dianæ. *Ehr*. 26
,, v. *Jenneri*. Kl. . 25
,, v. *typicum*. Kl. . 26
didymotocum. *Corda*. . 17
,, v. Baileyanum. *Br*. 18
digitus. Ehr. 40
,, Näg. 42
dilatatum. Kutz. . . . 28
directum. *Ar*. 18
doliolatum. Breb. . . 28
eboracense. *Turn*. 37, 185

CLOSTERIUM—(*continued*) PAGE
Ehrenbergii. *Men.* . . 23
gracile. *Breb.* 22
granulatum, Breb. . . 49
Griffithii. *Berk.* . . . 37
intermedium. *Ralfs.* . . 29
„ v. *directum.* K. 19
„ v. *juncidum.* Kl. 31
„ v. *typicum.* Kl. 30
interruptum. Jac. . . 41
Jenneri. *Ralfs.* . . . 24
juncidum. *Ralfs.* . . . 30
Kutzingii. *Breb.* . . . 34
laeve. Kutz. 50
lagoense. *Nord.* . . . 28
lamellosum. Breb. . . 40
lanceolatum. Cleve. . . 22
lanceolatum. *Kutz.* . . 21
Leibleinii. *Kutz.* . . . 25
lens. v. *intermedia.* Jac. 42
„ v. *minor.* Jac. . . 43
linea. *Perty.* 37
lineatum. *Ehr.* . . . 31
lunula. *Ehr.* . . . 19, 23
lunula. Kutz. 24
„ Leib. . . . 25
margaritaceum. Ehr. . 38
monile. Kutz. 48
moniliferum. *Ehr.* . 24, 25
„ v. *Ehrenbergiana.* 23
„ v. *Ehrenbergii.* Kl 23
„ v. *Leibleinii.* Kl 25
„ v. *Leibleiniana.* J. 25
„ v. *Mulleriana.* J. 24
„ v. *typicum.* Kl. . 24
monotænium. *Ar.* . . 25
nodosum. Bail. . . . 13
obtusum. *Breb.* . . . 19
praelongum. *Breb.* . . 22
Pritchardianum. *Ar.* . 22
pronum v. *acutum.* Kl. . 36
„ v. *cornu.* Kl. . 35
„ v. *linea.* Kl. . 37
Ralfsii. *Breb.* 32
„ v. *typicum.* Kl. . 33
rostratum. *Ehr.* . . . 33
rostratum. Ralfs. . . . 33
„ Bail. 34
„ v. *setaceum.* Kl. 34
ruficeps. Ehr. 26
sceptrum. Kutz. . . . 16
setaceum. *Ehr.* . . . 34
spiraliferum. Jac. . . 39
striolatum. Ehr. . . . 29
„ v. *costatum.* Kl. 28
„ v. *elongatum.* R. 30
„ v. *intermedia.* J. 30
„ v. *typicum.* Kl. . 29
„ v. *ulna.* Jac. . . 19
„ v. *vulgaris.* J. . 29

CLOSTERIUM—(*continued*) PAGE
subrectum. Breb. . . . 18
subtile. Breb.? 37
subulatum. *Kutz.* . . . 30
sulcatum. Breb. . . . 36
tenue. Kutz. 35
tenerrimum. Kutz. . . 36
trabecula. Bail. . . . 15
„ Ehr. 14
trabeculoides. Corda. . 16
truncatum. Breb. . . . 16
„ Kutz. . . . 14
turgidulum. Kutz. . . 28
turgidum. Ehr. . . . 21
„ v. *didymotocum.* . 18
„ v. *typicum.* K. . 21
venus. Kutz. 26
CONFERVA.
dissiliens. Sm. 7
mucosa. Mert. 8
Cosmarium. *Corda.* . . . 79
aculeatum. Men. . . . 131
amœnum. *Breb.* . . . 110
anceps. *Lund.* 82
angulosum. *Breb.* . . . 93
angustatum. Nordst. . . 76
annulatum. Archer. . . 122
antilopeum. Breb. . . 132
armatum. Breb. . . . 130
asphaerosporum. *N.* . 92, 206
attenuatum. Breb. . . 127
bicrenatum. *Nord.* . . 96
binale. Men. 76
binerve. *Lund.* 80
bioculatum. *Breb.* . . 89
bioculatum. Men. . . . 93
biretum. *Breb.* 108
„ v. triquetrum. *B.* 109
Böeckii. *Wille.* . . . 111
botrytis. *Meneg.* . . . 105
Brebissonii. Jacobs. . . 110
Brebissonii. *Meneg.* . . 100
Broomei. *Thw.* . . . 109
calcareum. *Wittr.* . . 94
cambricum. *C. & W.* . 98
circulare. Kutz. . . . 71
cœlatum. *Ralfs.* . . . 111
commisurale. *Breb.* . . 113
„ v. acutum. *Br.* 113
confusum. *Cke.* . . . 110
connatum. Breb. . . . 124
„ v. *typicum.* Kl. . 124
„ v. *pseudoconnatum* 124
conspersum. *Ralfs.* . . 101
corbula. *Breb.* 107
coronatum. *C. & W.* . 108
crassum. Breb. 65
crenatum. *Ralfs.* . . . 95
„ v. *bicrenatum.* Nord. 96
cristatum. *Ralfs.* . . . 114

COSMARIUM—(*continued*) PAGE
cucumis. *Corda*. . . . 84
cucumis. Hass. . . . 85
„ v. *quadratum*. Kl. 80
„ v. *typicum*. Kl. . 85
cucurbita. Breb. . . . 125
„ v. *typicum*. Kl. 125
curtum. Breb. 127
„ v. *majus*. Rab. . 127
cyclicum. *Lund*. . . . 116
cylindricum. Ralfs. . . 122
cymatopleurum. *Nordst*. 188
De Baryi. Archer. . . 128
„ v. *typicum*. Kl. 128
„ v. *turgidum*. Kl. 128
deltoides. Corda. . . . 106
didelta. Men. 70
„ Kutz. 107
discretum. *Benn*. . . . 188
elegans. Breb. . . . 74
exiguum. *Ar*. . . . 92
galeritum. *Nord*. . . . 87
gemmatum. Breb. . . . 73
gemmiferum. Nordst. . . 118
globosum. *Buln*. . . . 121
gotlandicum. *Wittr*. . 88
granatum. *Breb*. . . . 83
„ v. *typicum*. Kl. 83
Hammeri. *Reinsch*. . . 81
„ v. hibernicum. *A*. 81
hexalobum. *Nordst*. . . 116
hexastichum. *Lund*. . . 115
holmiense. *Lund*. . . . 96
homalodermum. *Nord*. . 82
incus. Breb. 135
isthmochondrium. *N*. . 114
Jacobseni. *Roy*. . . . 120
Kjellmanni. *Wille*. . . 113
laeve. *Rabh*. 94
„ v. septentrionale. *W*. 94
lasiosporum. *Ar*. . . . 92
latum. *Breb*. 101
lobatosporum. *Ar*. . . 121
Logiense. *Bis*. 104
margaritiferum. *Turp*. . 102
margaritiferum. Kutz. . 100
„ Auct. . . 104
„ v. *genuina*.
Nord. . 104
„ v. *reniforme*.
Ralfs. . 104
melanosporum. *Ar*. . . 188
Meneghinii. *Breb*. . . 93
„ v. *angulosum*. Kir. 93
minutissimum. *Ar*. . . 91
moniliferum. Jacobs. . 120
moniliforme. *Turp*. . . 119
monomazum. *Lund*. . 99
„ v. polymazum. *N*. 99
notabile. *Breb*. . . . 118

COSMARIUM—(*continued*) PAGE
notabile. v. minor. *Wille*. 118
Nymannianum. *Grun*. . 82
obliquum. *Nordst*. . . 94
oblongum. Bennett. . . 123
„ Breb. . . . 65
ochthodes. *Nord*. . . . 109
orbiculatum. *Ralfs*. . . 119
ornatum. *Ralfs*. . . . 112
orthostichum. *Lund*. . 105
ovale. *Ralfs*. . . 86, 100
pachydermum. *Lund*. . 85
[illegible] Breb. . . . 125
parvulum. *B*[illegible]. . . . 120
pectinatum. Breb. . . . 72
phaseolus. *Breb*. . . . 88
„ v. *bioculatum*. Kl. 90
„ v. *typicum*. Kl. . 88
platyisthmum. *Ar*. . . 187
plicatum. *R*[illegible]. . . 81
„ v. sinuosum. *L*. 81
Portianum. *Ar*. . . . 103
præmorsum. *Breb*. . . 107
protractum. Cleve. . . 107
pseudarctoum. Nord. . 129
pseudoconnatum. Nord. . 124
pseudonitidulum. *Nordst*. 87
„ v. obsoletum. 88
pseudopyramidatum. *Lund*. 86
punctulatum. *Breb*. . . 104
pygmæum. *Ar*. . . . 91
pyramidatum. *Breb*. . 86
pyramidatum. Ralfs. . 87
„ v. *intermedia*. N. 82
„ v. *typicum*. Kl. . 86
„ v. *minus*. Rein. . 87
quadratum. *Ralfs*. . . 80
quadratum. var. Ralfs. . 81
quadrifarium. *Lund*. . 115
quadrum. *Lund*. . . . 102
quarternarium. *W*. & *N*. 102
quinarium. *Lund*. . . 114
Ralfsii. *Breb*. 85
„ v. *typicum*. Kl. . 85
rectangulare. Grun. . . 88
Regnesii. *Reinsch*. . . 95
Reinschii. *Ar*. 96
reniforme. *Ar*. . . . 104
Schliephackianum. *Grun*. 92
„ v. Spitzbergensis. *N*. 92
sinuosum. Corda . . . 65
„ Wille. 81
speciosum. *Lund*. . . . 117
sphæricum. *Benn*. . . 189
sphalerostichum. *N*. & *W*. 111
sportella. *Breb*. . . . 107
sublobatum. *Breb*. . . 79
subspeciosum. *Nord*. . . 117
tenue. *Ar*. 92
tetrachondrium. *Lund*. . 89

COSMARIUM—(*continued*) PAGE
tetragonum. *Näg.* . . . 98
„ v. Lundellii. *C.* 98
tetraophthalmum. *Breb.* 99
Thwaitesii. Ralfs. . . . 126
„ v. *typicum.* Kl. 126
„ v. *curtum.* Kl. 127
tinctum. *Ralfs.* 90
trafalgaricum. *Wittr.* . 89
truncatellum. *Perty.* . 91
truncatum. Corda. . . 61
tuberculatum. Archer. . 123
turgidum. Breb. 127
Turpini. *Breb.* 106
„ v. cambricum. *J.* 107
undulatum. *Corda.* . . 97
variolatum. *Lund.* . . 84
venustum. Rabh. . . . 78
verrucosum. Men. . . 64
Wittrockii. *Lund.* . . . 118
Wrightianum. *Ar.* . . . 187
Cosmocladium. *Breb.* . . 78
constrictum. *Ar.* . . . 79
pulchellum. Buln. . . 79
Saxonicum. *D. By.* . . 78
Cosmosporæ. 53
CYLINDROCYSTIS. *Men.* . . 46
Brebissonii. Men. . . 43
crassa. *D. By.* . . . 46
diplospora. *Lund.* . . 46
truncata. Breb. . . . 44
CYMBELLA.
Hobkirkii. Moore. . . . 21
reniformis. Ag. . . . 103
Desmidium. *Ag.* 9
aculeatum. Ehr. . . . 174
apiculosum. Ehr. . . . 159
aptogonum. *Breb.* . . 11
bifidum. Ehr. 163
Borreri. Ralfs. . . . 9
compressum. Corda. . . 10
cylindricum. *Grev.* . . 9
glabrum. Ehr. 143
hexaceros. Ehr. . . . 168
mucosum. Breb. . . . 7
orbiculare. Ehr. . . . 157
quadrangulare. Kutz. . 11
quadrangulatum. *Ralfs.* 11
ramosum. Ehr. 154
Swartzii. *Ralfs.* . . . 10
DIATOMA.
Swartzii. Ag. 11
DICTYOSPHÆRIUM.
constrictum. Ar. . . . 79
DIDYMIDIUM.
apiculatum. Reinsch. . 186
DIDYMOCLADON.
longispinum. Bail. . . 165
furcigerum. Ralfs. . . 178
sexangularis. Buln. . . 179
DIDYMOPRIUM. PAGE
Borreri. Ralfs. . . . 9
cylindricum. Ralfs. . . 10
Grevillei. Kutz. . . . 10
Docidium. *Breb.* 12
asperum. Breb. . . . 3
„ Ralfs. . . . 2
baculum. *Breb.* . . 16
clavatum. *Kutz.* . . . 14
coronatum. *Breb.* . . 13
crenulatum. Ehr. . . 15
Ehrenbergii. *Ralfs.* . . 14
granulatum. *Benn.* . . 184
hirsutum. *Bail.* . . . 17
minutum. *Ralfs.* . . 16
nobile. *Lund.* 13
nodosum. *Bail.* . . . 12
nodulosum. *Breb.* . . 15
trabecula. Wolle. . . . 14
truncatum. *Breb.* . . 15
turgidum. Wittr. . . . 128
DYSPHINCTIUM.
annulatum. Näg. . . . 123
cylindrus. Näg. . . . 39
Menegh[illegible] Näg. . 124
R[illegible] Näg. . . 127
turgidum. Delp. . . . 128
ECHINELLA.
acuta. Lyngb. 36
oblonga Grev. . . . 65
rotata. Grev. 58
ENDOSPIRA.
bryophila. Breb. . . . 52
Euastrum. *Ehr* 63
affine. *Ralfs.* 67
americanum. Ehr. . . 56
ampullaceum. *Ralfs.* . 68
angulosum. Breb. . . 93
„ Ehr. . . . 106
ansatum. *Ralfs.* . . . 70
apiculatum. Ehr. . . . 186
armatum. Kutz. . . . 130
Armstrongianum. *Archer* 186
bidentatum. Näg. . . . 74
binale. Kutz 71
binale. *Ralfs.* 75
„ b. denticulatum. 186
K. 76
„ v. angustatum. *W.* 76
„ v. insulare. *W.* . 77
„ v. elobatum. *Lund.* 77
botrytis. Ehr. 106
circulare. *Hass.* . . . 71
„ v. *Hassallii.* Br. 71
„ *var.* B. Ralfs. . 71
„ v. *Falasiensis.* 186
B. 72
„ v. *Ralfsii.* Br. 72
convergens. Kutz. . . . 137

EUASTRUM—(*continued*) PAGE
crassum. *Kutz.* . . . 65
,, v. cornubiense . 187
crenatum. *Kutz.* . . . 78
crenulatum. *Benn.* . . 187
crenulatum. Näg. . . 93
crux-melitensis. Ehr. . 56
cuneatum. *Jenner.* . . 70
depressum. Näg. . . . 88
didelta. *Ralfs.* . . 69, 71
dubium. Näg. 76
elegans. *Breb.* . . . 74
,, v. *inerme.* Ralfs. 75
,, v. *rostratum.* R. 74
,, v. spinosum. *Ralfs.* . . . 75
erosum. *Lund.* . . . 77
fasciculatum. Kutz. . . 131
gemmatum. Ralfs. . . 72
gemmatum. Kutz. . . 73
Hassallianum. Näg. . . 73
hirsutum. Kutz. . . . 149
humerosum. Ralfs. . . 66
inerme. *Lund.* 75
insigne. *Hass.* . . . 69
insulare. Wolle. . . . 77
integerrimum. Ehr. . . 84
Jenneri. *Archer.* . . . 72
lobulatum. Breb. . . . 76
Lundellii. Benn. . . 77
margaritiferum. Ehr. . 103
,, Focke. . 110
multilobatum. *Wood.* . 67
oblongum. *Grev.* . . . 64
,, v. integrum 187
octocorne. Kutz. . . . 134
ornithocephalum. *Ben.* . 78
papulosum. Kutz. . . 64
pecten. Ehr. 65
pectinatum. *Breb.* . . 72
pelta. Hass. 65
pinnatifidum. Kutz. . . 54
pinnatum. *Ralfs.* . . . 66
polare. Nordst. . . . 76
Ralfsii. Rabh. . . . 70
retusum. Kutz. . . . 136
rostratum. *Ralfs.* . . 73
rota. Ehr. . 57, 58, 59, 61
scutum. Focke. . . . 61
semiradiatum. Breb. . 61
sinuosum. *Lenor.* . . 71
sinuosum. Kutz. . . . 95
sol. Ehr. 60
spinosum. Hass. . . . 75
spinuligerum. Breb. . . 186
sublobatum. Breb. . . 80
tetragonum. Nag. . . . 98
tetraophthalmum. Kutz. 100
truncatellum. Perty. . . 91
ventricosum. *Lund.* 67

EUASTRUM—(*continued*) PAGE
venustum. *Breb.* . . . 77
verrucosum. *Ehr.* . . 63
EUTOMIA.
oblonga. Harv. . . . 65
rotata. Harv. 58
FRUSTULIA.
acuta. Kutz. 36
subulata. Kutz. . . . 36
Genicularia. *D.By.* . . 184
spirotænia. *D.By.* . . 184
GLEOPRIUM.
dissiliens. Berk. . . . 7
mucosum. Hass. . . . 8
Gonatozygon. *D.B.* . . 2
asperum. Rabh. . . . 2
,, Cleve. . . . 3
Brebissonii. *D.By.* . . 2
Kinahani. *Ar.* . . . 3
Ralfsii. *D.By.* . . . 2
spirotænium. *D.By.* . . 184
GONIOCYSTIS.
aculeatum. Hass. . . . 174
arachnis. Hass. . . . 182
bifida. Hass. 167
dilatata. Hass. . . . 163
gracilis. Hass. . . . 171
hexaceros. Hass. . . . 162
Jenneri. Hass. . . . 181
margaritacea. Hass. . 181
mucronata. Hass. . . 139
muricata. Hass. . 149, 159
orbicularis. Hass. . . 157
paradoxum. Hass. . . 171
tetracerum. Hass. . . 183
GYMNOZYGA.
bambusina. Jacob. . . 9
HETEROCARPELLA.
binalis. Turp. 76
bioculata. Breb. . . . 90
botrytis. Bory. . . . 106
didelta. Turp. . . 106, 69
tetraophthalma. Kutz. . 100
HOLOCYSTIS. Hass.
oscitans. Hass. . . . 54
Hyalotheca. *Ehr.* . . . 7
cylindrica. Ehr. . . . 10
dissiliens. *Sm.* . . . 7
mucosa. Kutz. 7
mucosa. *Mert.* . . . 8
Ralfsii. Kutz. . . . 8
ISTHMIA.
vertebrata. Men. . . . 4
ISTHMOSIRA.
excavata. Kutz. . . . 4
filiformis. Kutz. . . . 5
vertebrata. Kutz. . . 4
Leiosporæ. 2
LEPTOCYSTINEMA.

LEPTOCYSTINEMA—(*cont.*) PAGE
Portii. Ar. 3
Kinahani. Ar. 3
LUNULINA.
monilifera. Bory. . . . 23
vulgaris. Bory. . . . 20
Mesotænium. *Näg.* . . . 47
armillare. Delp. 8
chlamydosporum. *D.By.* 47
Grayi [illegible] 48
mirificum. *Ar.* . . . 47
violascens. *D.By.* . . 47
Micrasterias. *Ag.* . . . 53
americana. (*Ehr.*) . . 56
angulosa. *Hant.* . . . 62
apiculata. *Meneg.* . . 186
brachyptera. *Lund.* . . 63
conferta. *Lund.* . . . 59
cornuta. *Benn.* . . . 57
crenata. *Breb.* 61
crenata. Cleve. . . . 59
crux-melitensis. *Ehr.* . 55
„ v. *furcata.* R. 55
denticulata. *Breb.* . . 56
„ v. *Thomasiana.* J. . 58
fimbriata. *Ralfs.* . . . 59
„ v. *ornata.* Buln. 186
furcata. *Ag.* 55
furcata. Rabh. 58
„ v. *denticulata.* R. 57
granulata. Wood. . . 59
Jenneri. *Ralfs.* . . . 62
„ v. *angulosa.* Rab. 63
margaritifera. Breb. . 103
melitensis. Ralfs. . . . 55
„ v. *gracilis.* Kutz. 55
morsa. Ralfs. 56
mucronata. *Dixon.* . . 53
octocornis. Men. . . . 135
oscitans. *Hass.* . . . 54
„ v. *pinnatifida.* R. 55
papillifera. *Breb.* . . . 60
pinnatifidum. *Kutz.* . . 54
radiata. Hass. 55
radiosa. *Ag.* 59
rota. Men. 57
rotata. *Grev.* 57
rotata. Ralfs. . . . 61, 57
semiradiata. Kutz. . . 61
sinuata. Breb. 63
staurastrum. Kutz. . . 171
tetracera. Kutz. . . . 182
Thomasiana. *Ar.* . . . 58
tricera. Kutz. 182
truncata. *Corda.* . . 60
truncata. var. *c.* Rabh. . 61
MULLERIA.
lunula. Le Cl . . . 20

PAGE
ODONTELLA
desmidium. Ehr. . . . 12
unidentata. Ehr. . . . 4
Onychonema. *Wall.* . . 6
Nordstedtiana. *Turn.* . 6
PALMELLA.
cylindrospora. Breb. . . 43
PALMOGLÆA.
chlamydospora. Rabh. . 47
endospora. Kutz. . . . 52
mirifica. Rabh. . . . 47
violascens. Rabh. . . . 47
Penium. *Breb.* 38
annulatum. Archer . . 123
Berginii. Ar. 43
Brebissonii. Kutz. . . . 50
Brebissonii. *Ralfs.* . . 43
„ v. Jenneri, *R.* 43
„ v. *typicum.* Kl. 43
clandestinum. Kutz. . . 125
closterioides, *Ralfs.* . . 41
„ v. *navicula.* Kl. 43
crassiusculum. *D.By.* . . 44
cucurbitinum. *Bis.* . . 46
curtum. Breb. 126
cylindrus. *Breb.* . . . 39
didymocarpum. *Lund.* . 44
digitus. *Breb.* 40
„ v. *interruptum.* Kl. 41
diplosporum. Jacob. . . 46
granulatus. Kutz. . . . 49
interruptum. *Breb.* . . 41
Jenneri. Ralfs. . . . 43
lagenarioides. *Roy.* . . 45
margaritaceum. *Breb.* . 38
minutissimum. *Nord.* . 45
minutum. Cleve. . . . 17
Mooreanum. *Ar.* . . . 44
Nägelii. *Breb.* 42
navicula. *Breb.* . . . 42
oblongum. D. By. . . . 40
orbiculatum. Kutz. . . 119
phymatosporum. *Nord.* . 40
pusillum. Delp. . . . 46
Ralfsii. D. By. . . . 17
„ Kutz. . . . 122
rufopellitum. *Roy.* . . 185
rupestre. Rabh. . . . 46
spinospermum. *Josh.* . 45
spirostriolatum. *Bark.* . 39
[illegible] Kutz. 48
[illegible] . . . 126
truncatum. *Breb.* 44
PENTASTERIAS.
arachnis. Hass. . . . 182
margaritacea. Ehr. . . 181
PHYCASTRUM.
aculeatum. Kutz. . . . 174
apiculosum. Kutz. 180

PHYCASTRUM—(*continued*) PAGE
arachne. Kutz. 182
bifidum. Kutz. 163
crenulatum. Näg. 168
cristatum. Näg. 145
cuspidatum. Kutz. 141
cyrtocerum. Kutz. 169
depressum. Näg. 156
dilatatum. Kutz. 162
furcigerum. Kutz. 178
glabrum. Kutz. 143
gracile. Kutz. 171
Griffithsianum. Näg. 154
hexaceros. Kutz. 168
margaritaceum. Kutz. 181
monticulosum. Kutz. 148
muticum. Kutz. 156
orbiculare. Kutz. 157
paradoxum. Kutz. 171, 183
radiatum. Kutz. 182
Ralfsii. Näg. 168
„ Kutz. 167
rotundatum. Kutz. 181
spinulosum. Näg. 141
striolatum. Näg. 159
tricorne. Kutz. 168
trilobatum. Kutz. 168
tumidum. Kutz. 166
PITHISCUS.
angulosus. Kutz. 86
PLEUROSICYOS.
myriopodus. Corda. 40
PLEUROTÆNIUM. D. By.
baculum. D. By. 16
clavatum. D. By. 15
coronatum. Rabh. 13
cosmarioides. D. By. 128
crenulatum. Rabh. 15
Ehrenbergii. D. By. 14
hirsutum. Wood. 17
minutum. Delp. 17
nobile. Richt. 13
nodosum. Lund. 13
nodulosum. D. By. 15
trabecula. Näg. 14
truncatum. D. By. 16
„ Cleve. 44
turgidum. D. By. 128
SCHISTOCHILUM.
excavatum. Ralfs. 5
SCHIZOSPORA.
minor. Reinsch. 44
pachyderma. Reinsch. 46
Sphærozosma. *Corda* 3
elegans. Corda. 4
excavatum. *Ralfs*. 4
excavatum. Nordst. 91
filiforme. *Ehr*. 5
pulchellum. *Ar*. 6
pygmæum. *Rabh*. 5, 9

SPHÆROZOSMA—(*cont.*) PAGE
secedens. *D. By*. 51
tinctum. Rabh. 90
unidentatum. Ralfs. 4
vertebratum. *Ralfs*. 3
Spirotænia. *Breb*. 50
acuta. *Hilse*. 185
bryophila. *Breb*. 52
condensata. *Breb*. 50
erythrocephala. Br. 52
minuta. *Thur*. 51
muscicola. D. By. 52
obscura. *Ralfs*. 52
parvula. *Ar*. 51
tenerrima. *Ar*. 52
truncata. *Ar*. 51
SPONDYLOSIUM.
bambusioides. Wittr. 6
pulchellum. Ar. 6
secedens. Ar. 6
Staurastrum. *Meyen*. 138
acarides. *Nord*. 153
aculeatum. *Men*. 174
aculeatum. Ralfs. 174
„ v. *controversum* 174
alternans. *Breb*. 16
anatinum. *C. & W*.
apiculatum. *Breb*.
arachne. *Ralfs*. 18
„ v. *tetracera*. Jac. 183
arcuatum. *Nord*. 169
aristiferum. *Ralfs*. 141
armigerum. Breb. 146
artiscon. *Lund*. 179
asperum. *Breb*. 154
„ v. *proboscideum* 173
aversum. *Lund*. 166
avicula. *Breb*. 145
bidentatum. Wittr. 165
bifidum. *Breb*. 163
brachiatum. *Ralfs*. 167
Brasiliense. *Lund*. 165
Brebissonii. *Ar*. 150
brevispina. Cleve. 166
brevispina. *Breb*. 140
„ v. *Dickiæi*. Rab. 140
bullosum. *Benn*. 152
candianum. Delp. 147
capitulum. *Breb*. 161
„ v. amænum. *Hilse*. 161
„ v. Spetzbergense. *N*. 161
cerastes. *Lund*. 173
controversum. *Breb*. 173
convergens. Men. 137
cornubiense. *Benn*. 190
cornutum. *Archer*. 190
cristatum. *Näg*. 144
cuspidatum. *Breb*. 141
„ v. *Ralfsi*

STAURASTRUM—(*cont.*) PAGE
cyrtocerum. *Breb.* . . . 168
dejectum. Rabh. . . . 143
dejectum. *Breb.* . . . 138
„ v. lunatum. . . 139
„ v. directum. . . 139
„ v. mucronatum. . 139
„ v. *apiculatum.* L. 139
„ v. *Dickiæi.* Jac. 140
Dickiæi. *Ralfs.* . . . 140
dilatatum. *Ehr.* . . . 162
„ v. *tricorne.* Rab. 168
dispar. Breb. 162
elongatum. *Bark.* . . 172
enorme. *Ralfs.* . . . 183
eustephanum. *Ehr.* . . 177
furcatum. *Ehr.* . . . 146
„ v. armigerum. *Br.* 146
„ v. candianum. *D.* 147
„ v. *pseudofurcigerum* 147
furcigerum. *Breb.* . . 178
furcigerum. Rabh. . . 179
glabrum. *Kutz.* . . . 143
gracile. *Ralfs.* . . . 170
grande. *Buln.* 166
Griffithsianum. *Näg.* . 154
hirsutum. *Breb.* . . . 149
hystrix. *Ralfs.* . . . 151
inconspicuum. *N.* . . 158
iacus. Men. 136
inflexum. *Breb.* . . . 169
Jenneri Ralfs. . . . 181
Kjellmanni. *Wille.* . . 163
laeve. *Ralfs.* 180
„ v. Clevei. *Witt.* . 180
lævispinum. *Biss.* . . 143
lanceolatum. *Ar.* . . . 158
longispinum. *Bailey.* . 164
lunatum. *Ralfs.* . . . 143
maameuse. *Ar.* . . . 155
margaritaceum. *Men.* . 181
megacanthum. *Lund.* . 142
meriani. *Reinsch.* . . 161
mesoleium. *Archer* . . 190
monticulosum. *Breb.* . . 147
mucronatum. Lund. . . 139
„ B. Ralfs. . 138
muricatum. *Breb.* . . 159
muricatum. Ralfs. . . 150
muticum. *Breb.* . . . 156
„ v. *brevispina.* Jac. 140
nitidum. Archer. . . . 145
oligocanthum. *Breb.* . 145
O'Mearii. *Ar.* 142
ophiura. *Lund.* . . . 172
orbicalare. Men. . . . 166
orbiculare. *Ralfs.* . . . 156
„ v. extensum. *N.* 157
oxyacanthum. *Ar.* . . 175
paradoxum. Ehr. . . 183

STAURASTRUM—(*cont.*) PAGE
paradoxum. *Meyen.* . . 171
„ v. longipes. *N.* 171
„ v. *tetracerum.* . 182
pileolatum. *Breb.* . . 160
pilosum. *Näg.* . . . 150
pilosum. Breb. 150
„ v. *Brebissonii.* Rab. 151
polymorphum. *Breb.* . 169
„ v. *cyrtocerum.* Wood. . . 169
Pringsheimii. *Reinsch.* . 152
proboscideum. *Breb.* . 173
pseudocrenatum. Lund. 155
pseudofurcigerum. Cooke. 177
pseudofurcigerum *Rein.* 147
pterosporum. *Lund.* . 143
punctulatum. *Breb.* . . 160
pungens. *Breb.* . . . 141
pygmæum. *Breb.* . . 157
quadrangulare. *Breb.* . 164
„ v. major. R. . 161
quadrispinum. *Turn.* . 164
[illegible] [illegible] . . . 148
Royanum. *Ar.* . . . 152
saxonicum. *Reinsch.* . 155
sebaldi. *Reinsch.* . . 176
„ v. ornatum. *Nord* 176
sexangulare. *Buln.* . . 178
sexcostatum. *Breb.* . . 180
spinosum. Ralfs. . . . 146
spongiosum. *Breb.* . . 153
spongiosum. Rabh. . . 151
striolatum. *Näg.* . . . 158
subcruciatum. *C. & W.* 148
teliferum. *Ralfs.* . . . 151
„ v. convexum. 151
terebrans. Nord. . . . 172
tetracerum. *Ralfs.* . . 182
tricorne. *Breb.* . . . 167
tricorne. Ralfs. . . . 162
trilobum. Men. . . . 156
tuberculatum. *Benn.* . 149
tumidum. *Breb.* . . . 165
turgescens. *De Not.* . . 189
verticellatum. *Archer.* . 177
vestitum. *Ralfs.* . . . 175
STAUROCERAS.
acus. Kutz. 33
acutum. Grun. . . . 36
corna. Grun. 35
intermedium. Kutz. . . 34
subulatum. Kutz. . . 34
„ Breb. . . . 36
STEPHANOXANTHIUM.
eustephanum. Kutz. . . 177
monticulosum. Kutz. . 148
sexcostatum. Kutz. . . 181
TESSARTHRA.
filiformis. Ehr. . 5

TESSARTHRA—(*continued*) PAGE
moniliformis. Ehr. . . . 120
TESSARTHRONIA.
moniliformis. Turp. . . . 120
Tetmemorus. *Ralfs*. . . 48
Brebissonii. *Ralfs*. . . 48
granulatus. *Ralfs*. . . 49
granulatus. Ralfs. . . 50
lævis. *Ralfs*. . . . 49
penioides. *Benn*. . . . 50
TETRACHASTRUM. *Dixon*.
mucronatum. Dixon. . 54
oscitans. Dixon. . . . 54
pinnatifidum. Dixon. . 54
TRICHODICTYON.
rupestre. Kutz. 46
URSINELLA.
margaritifera. Turp. . 103
VIBRIO.
acerosus. Schr. . . . 20
lunula. Mull. 20
Xanthidium. *Ehr*. . . 129
aculeatum. *Ehr*. . . . 130
antilopeum. *Breb*. . . 132
armatum. *Breb*. . . . 129
artiscon. Archer. . . . 179

XANTHIDIUM—(*continued*) PAGE
bisenarium. Ehr. 131
Brebissonii. *Ralfs*. . . 130
,, v. varians. R. 131
concinnum. *Ar*. 189
convergens. Delp. . . . 136
coronatum. Ehr. . . . 178
cristatum. *Breb*. . . . 133
,, v. reniforme. *Ralfs*. 133
,, v. uncinatum. *Br*. 133
deltoideum. Corda. . . 159
fasciculatum. *Ehr*. . . 131
,, v. *polygonum*. . . 132
,, v. *antilopeum*. R. 132
furcatum. Ehr. 146
,, Ralfs. . . 130
hirsutum. Ehr. . . . 149
octocorne. Ehr. . . . 135
polygonum. Hass. . . 132
Robinsonianum. *Ar*. . 134
Smithii. *Ar*. 133
spinulosum. *Benn*. . . 132
ZYGOPHYCEÆ. 1
ZYGOXANTHIUM.
aculeatum. Kutz. 130, 131

ERRATA.

p. 63, line 24—After "Windermere" insert "Ireland."

p. 91—Cosmarium pygmæum, *Archer*, is affirmed to be a form of Cosmarium Schliephackianum, *Grun*. (p. 92), to which we do not wholly accede.

p. 92—Cosmarium Schliephackianum, var. Spitzbergensis, *N*., has been proposed as a distinct species, under the name of Cosmarium aspherospermum, *Nord*.

p. 95, line 18—After "Germany" insert "Sweden."

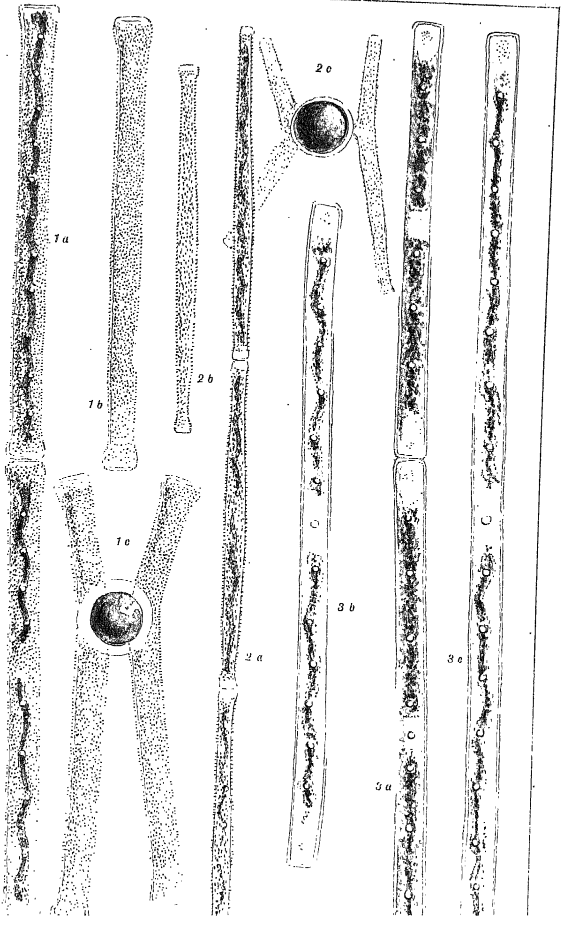
p. 102, line 32—For "Italy" read "Brazil."

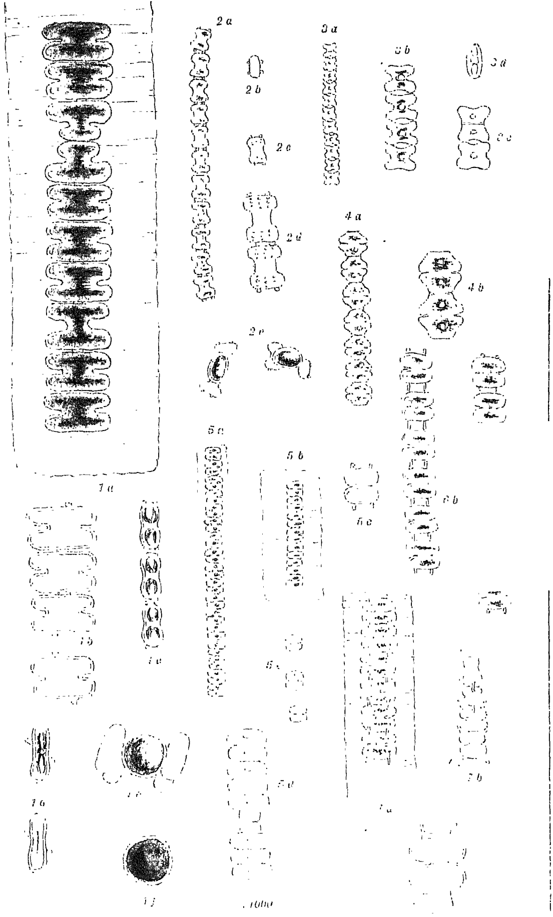
p. 115, line 4—After "Lake District" insert "Connemara."

. 118, line 20—After "Lake District" insert "Ireland."

LEWES:
H. WOLFF, PRINTER, 64, HIGH STREET.

PL. 1.

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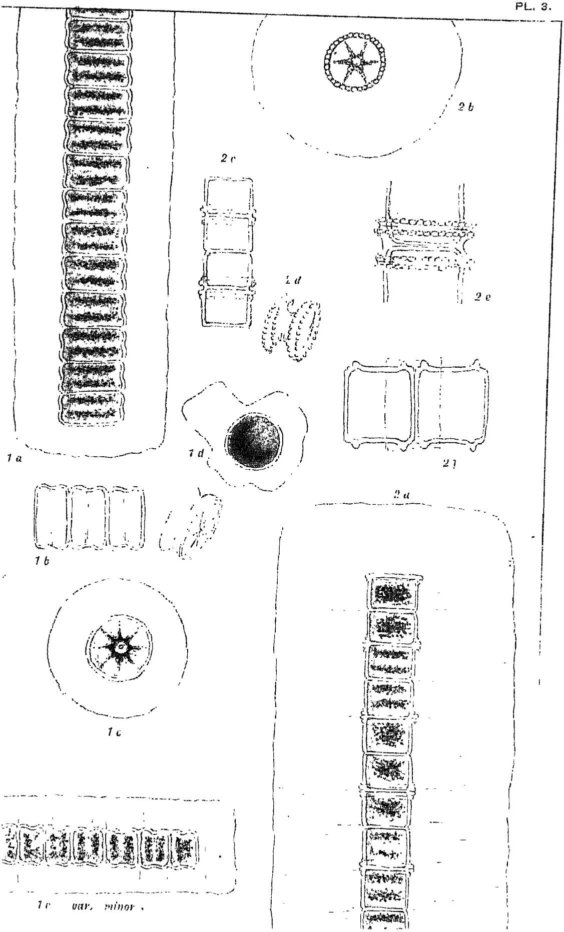
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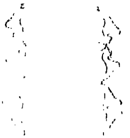
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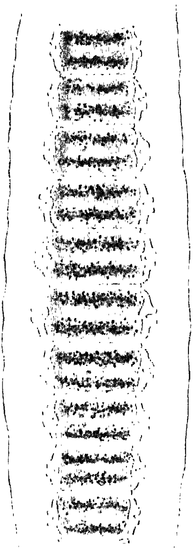
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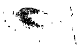
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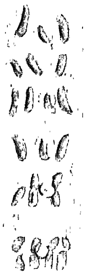

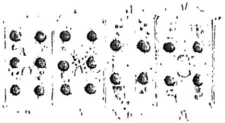
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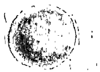
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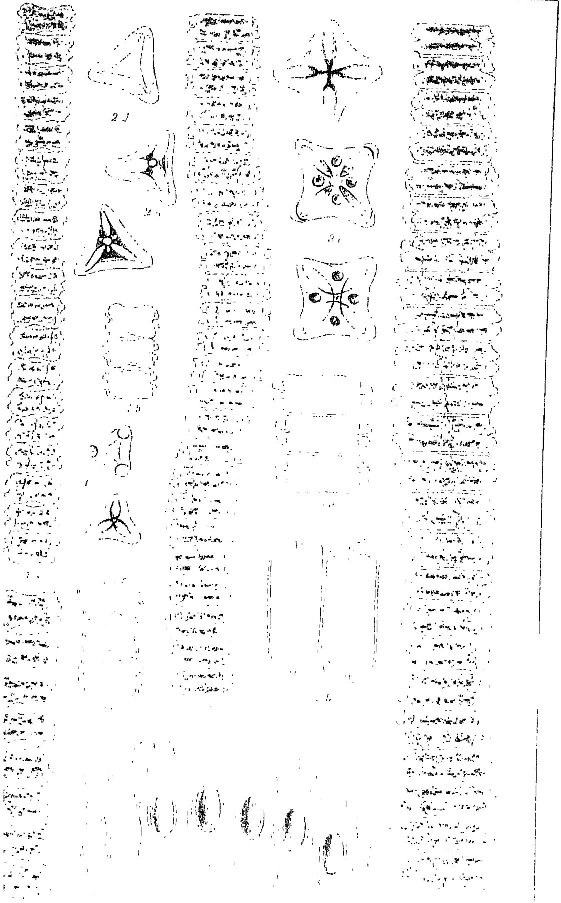

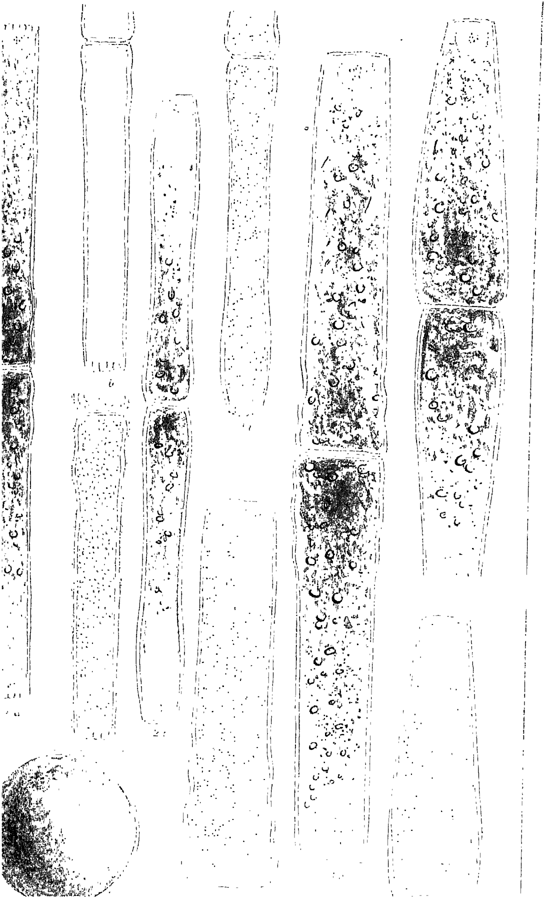

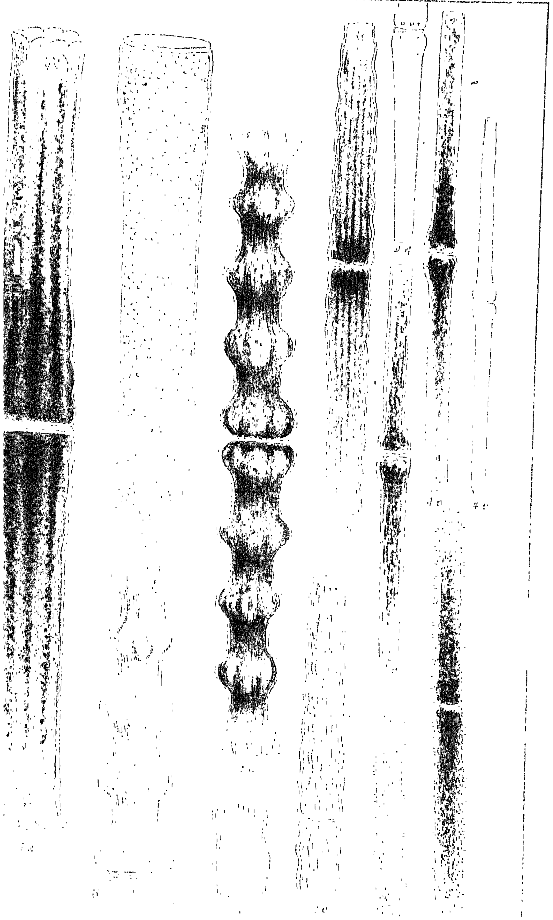
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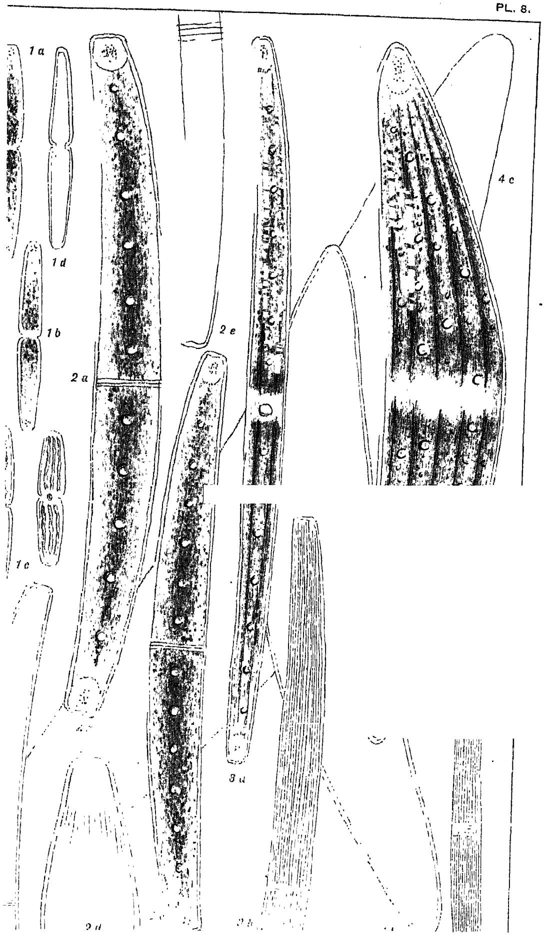
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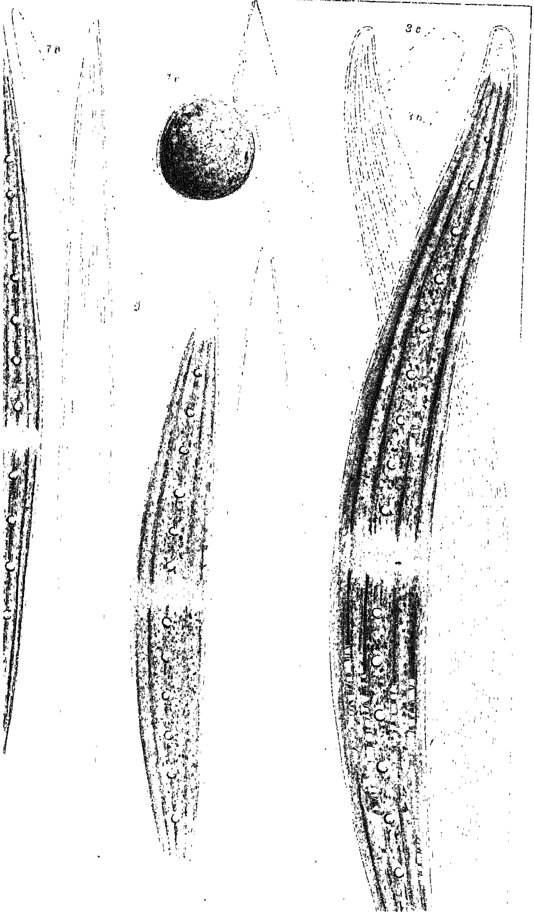
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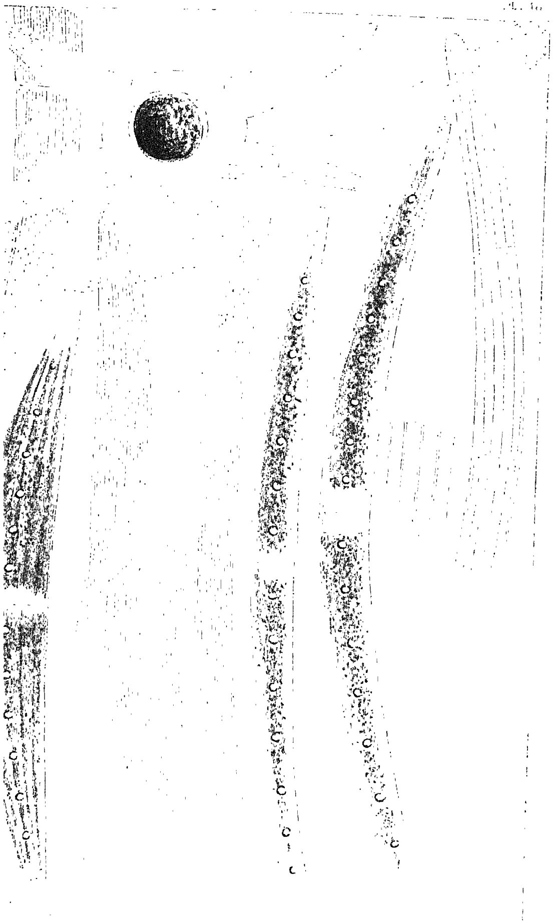

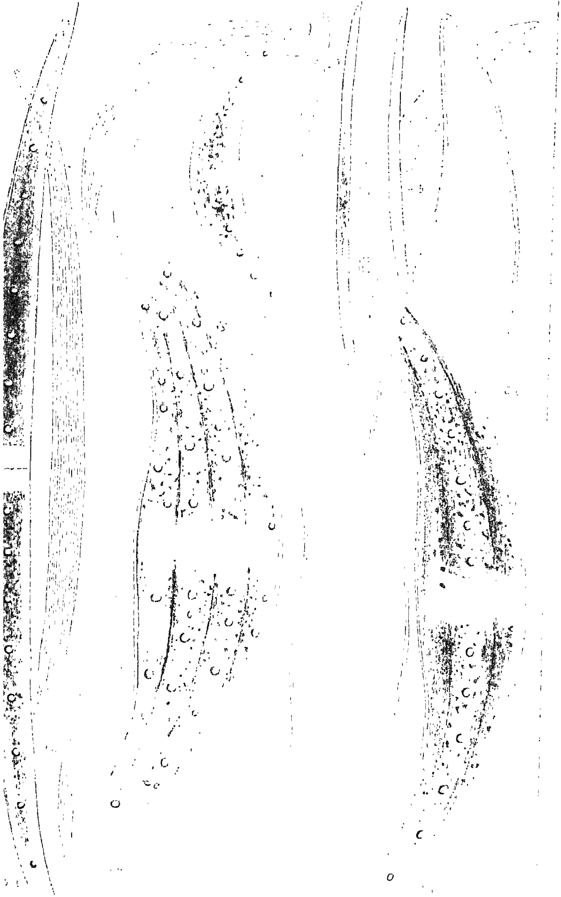

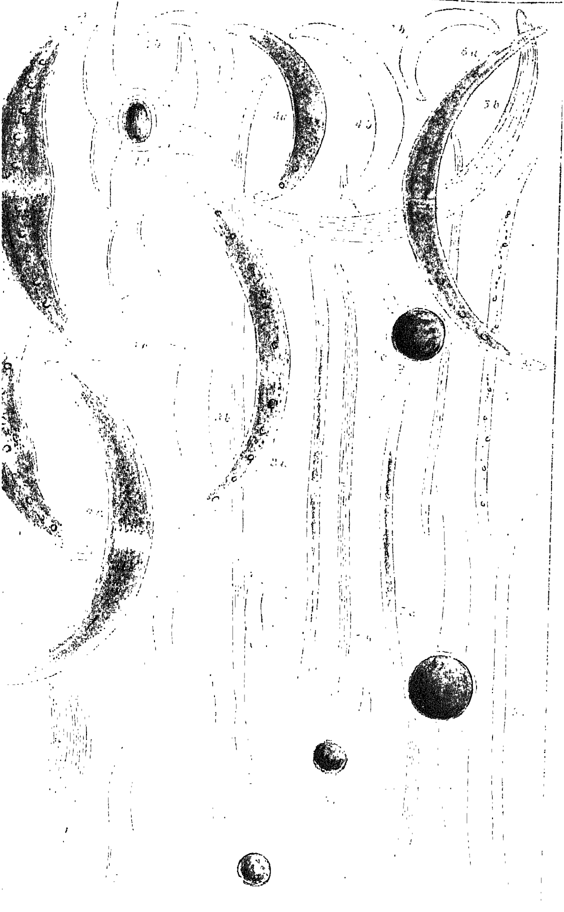
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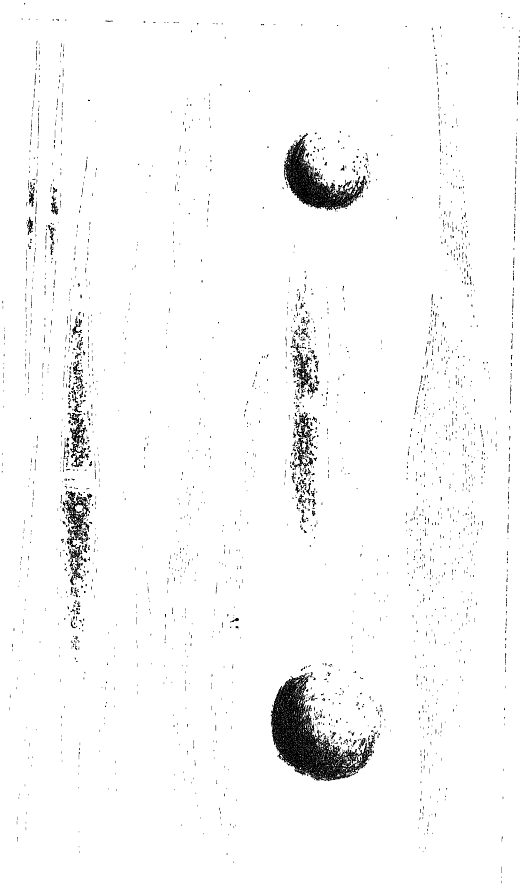

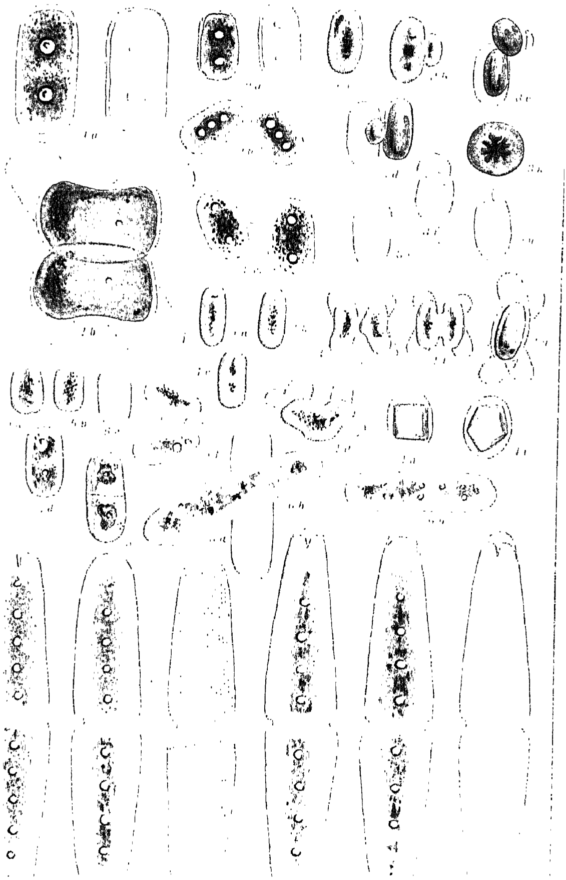
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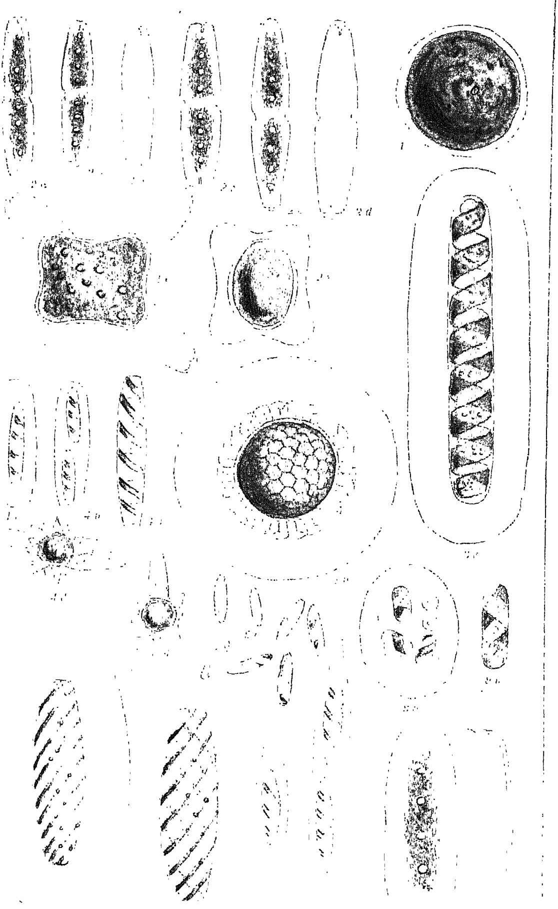
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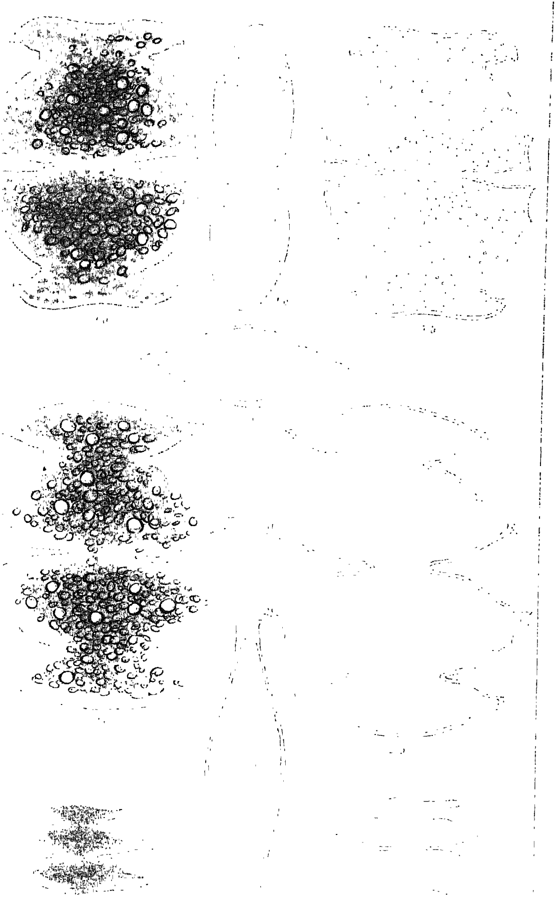

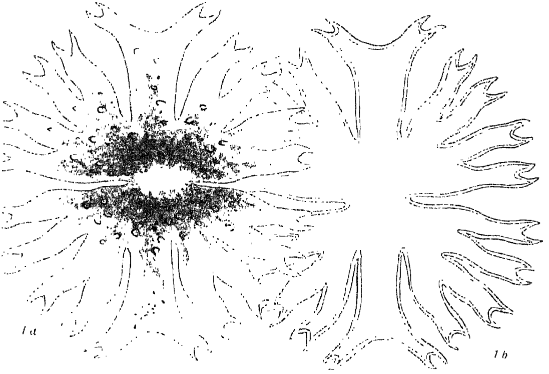
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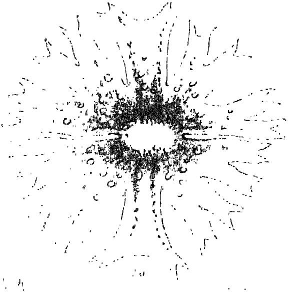
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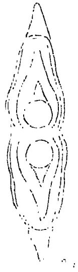

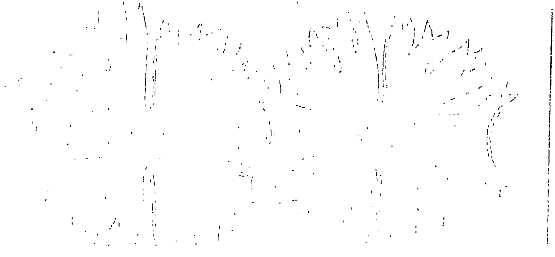

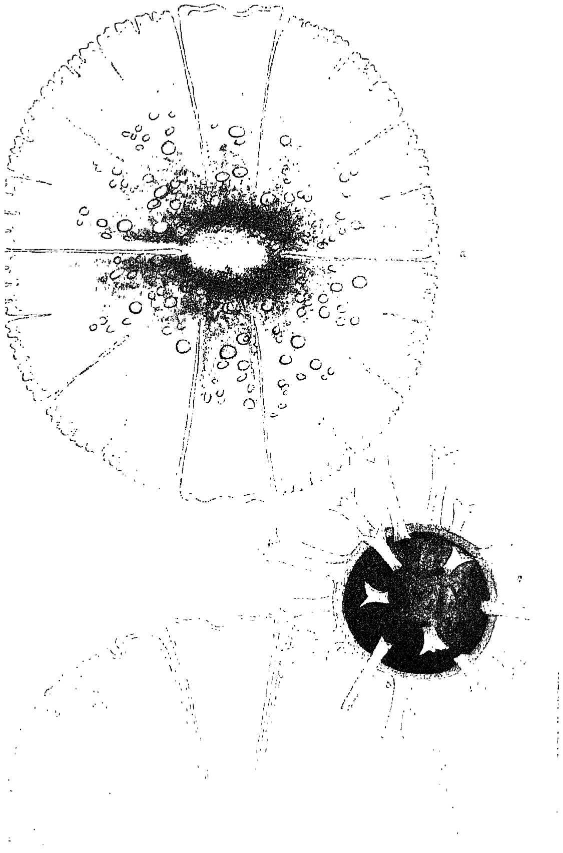
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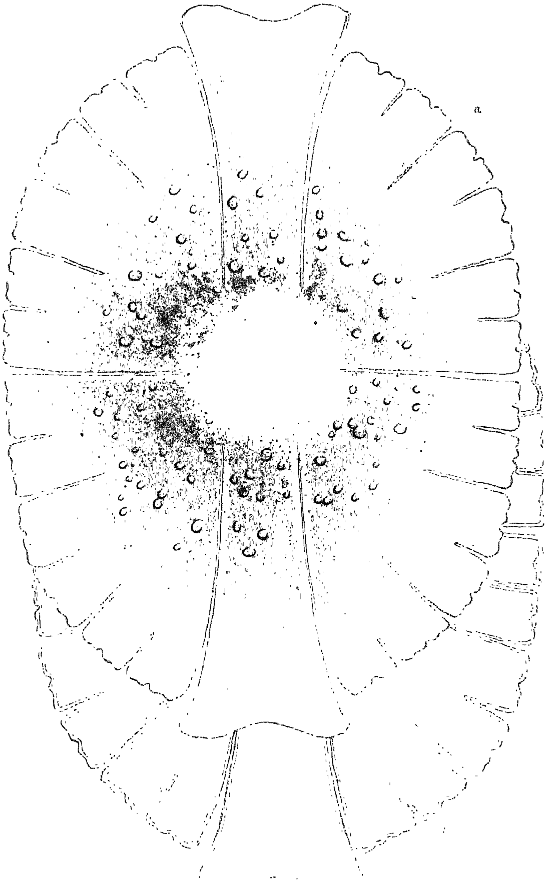
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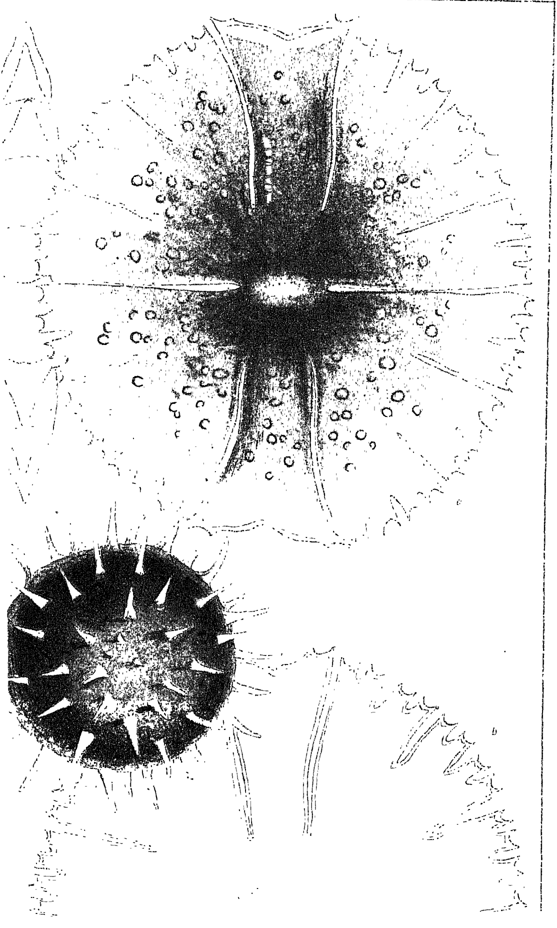

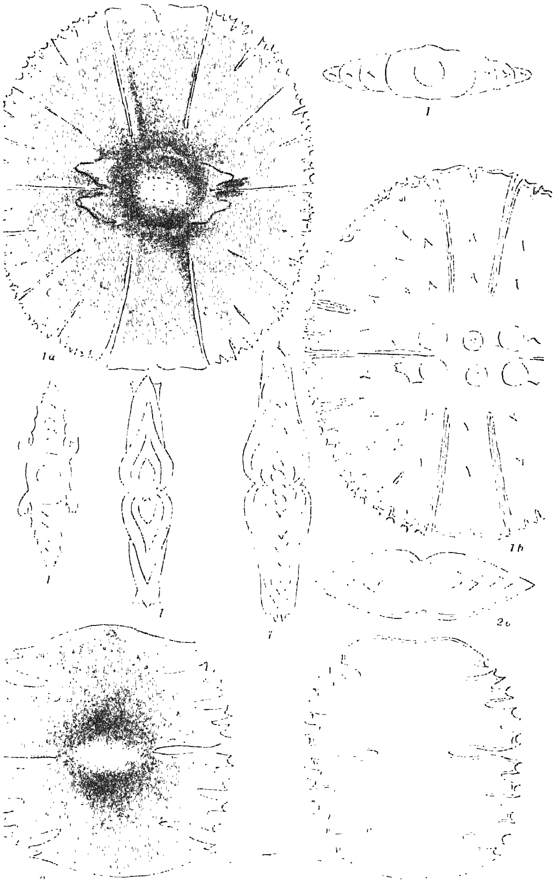
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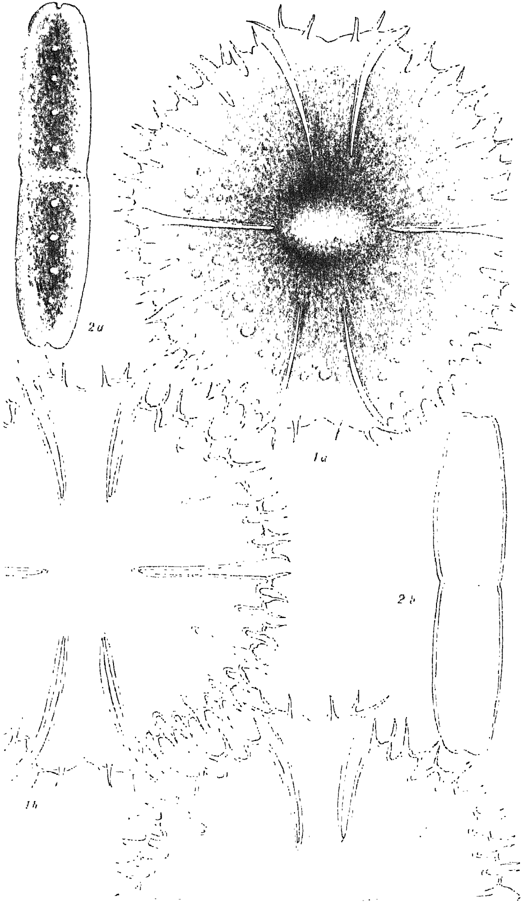
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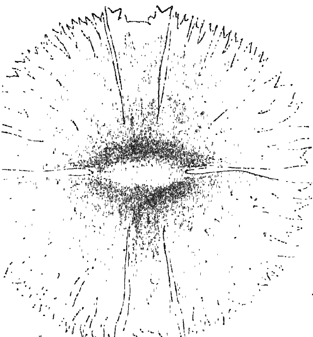

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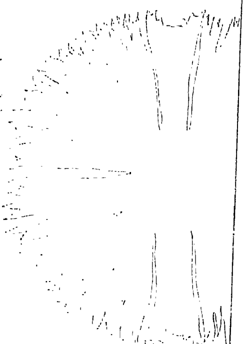

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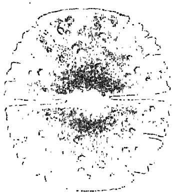

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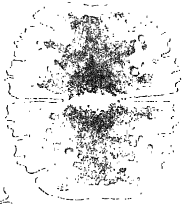

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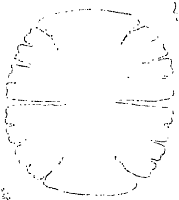

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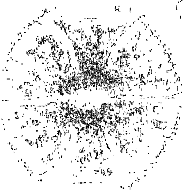

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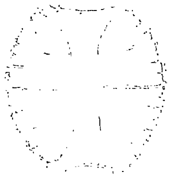

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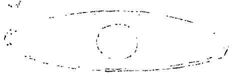

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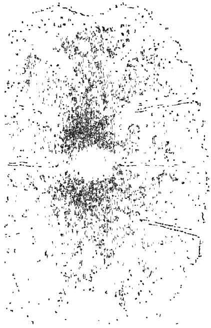

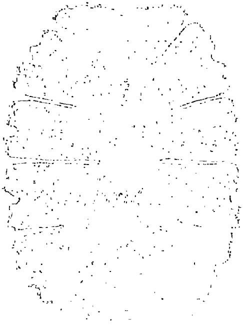

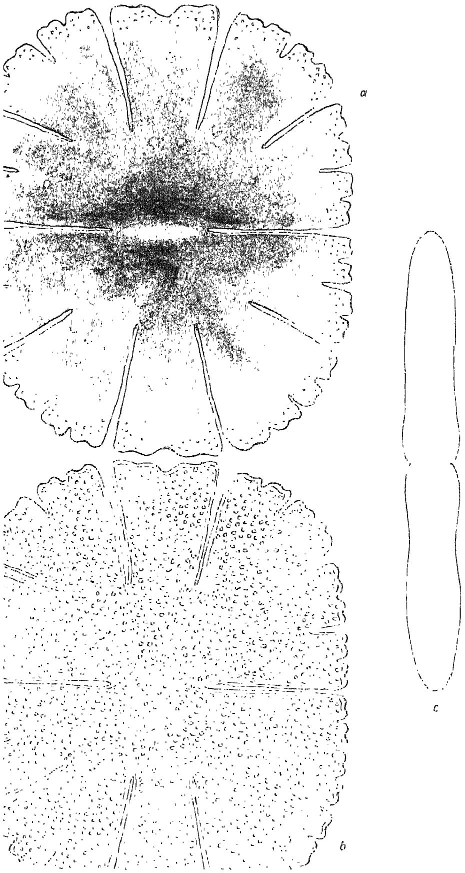
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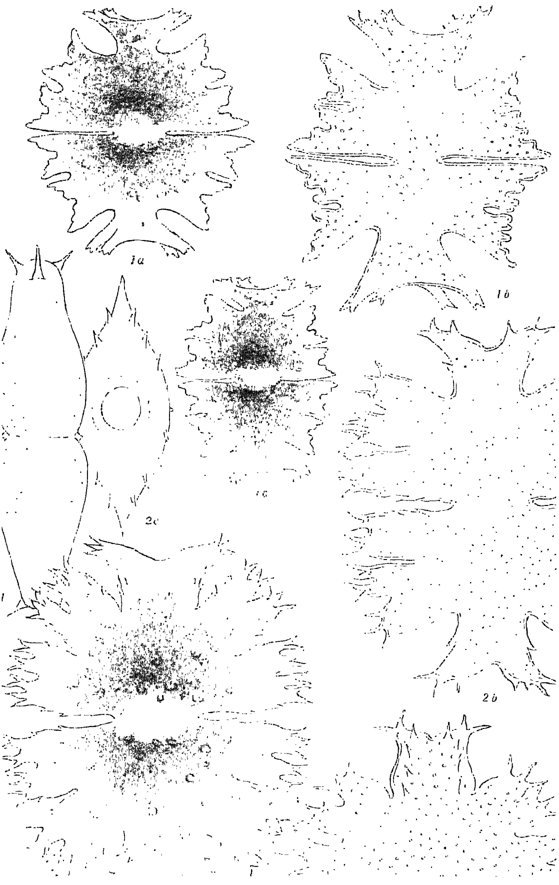
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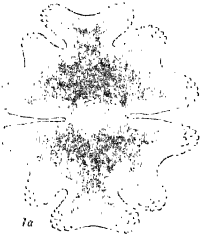

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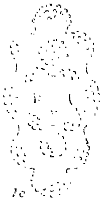

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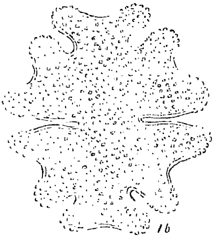

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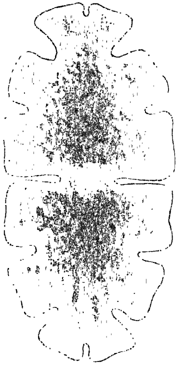

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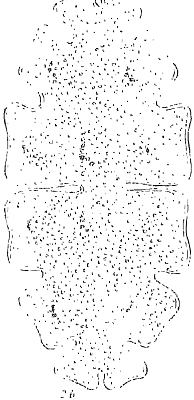

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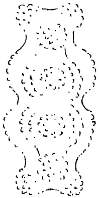

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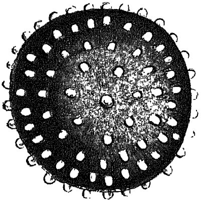

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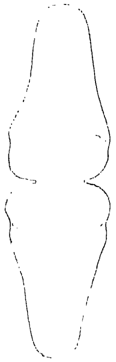

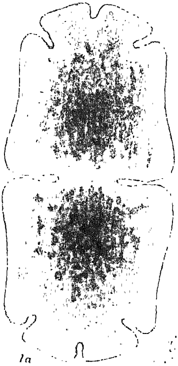

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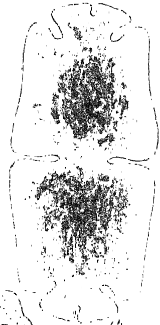

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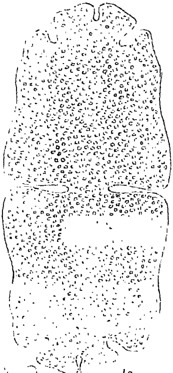

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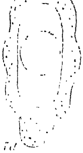

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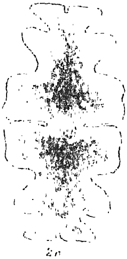

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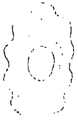

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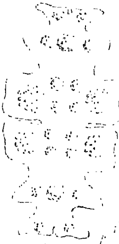

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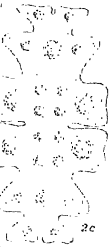

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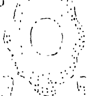

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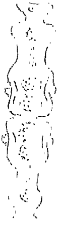
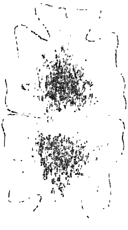
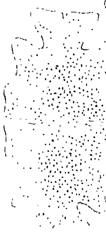
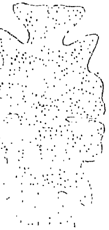
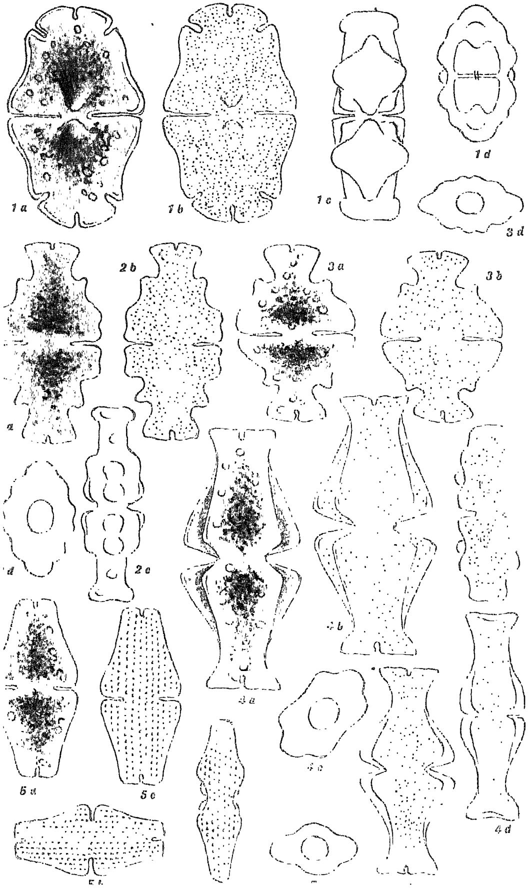


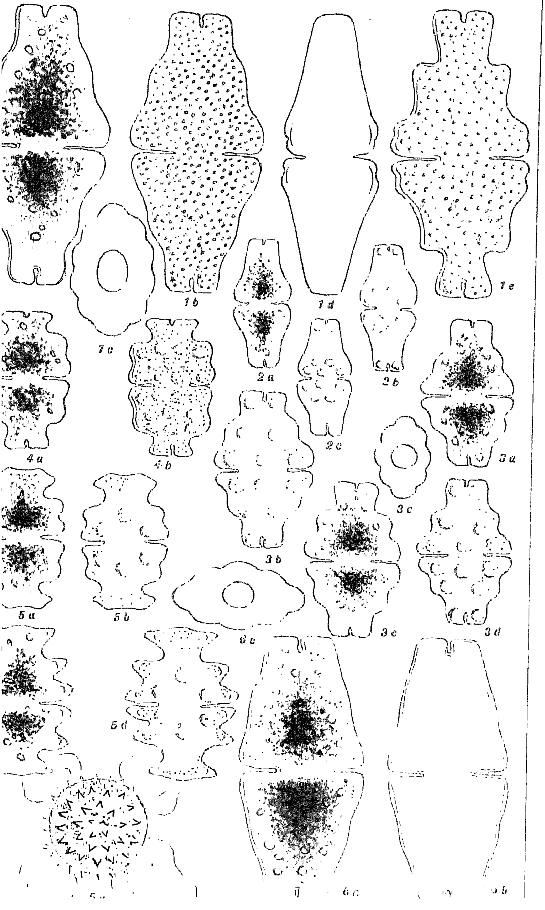






PL. 33.

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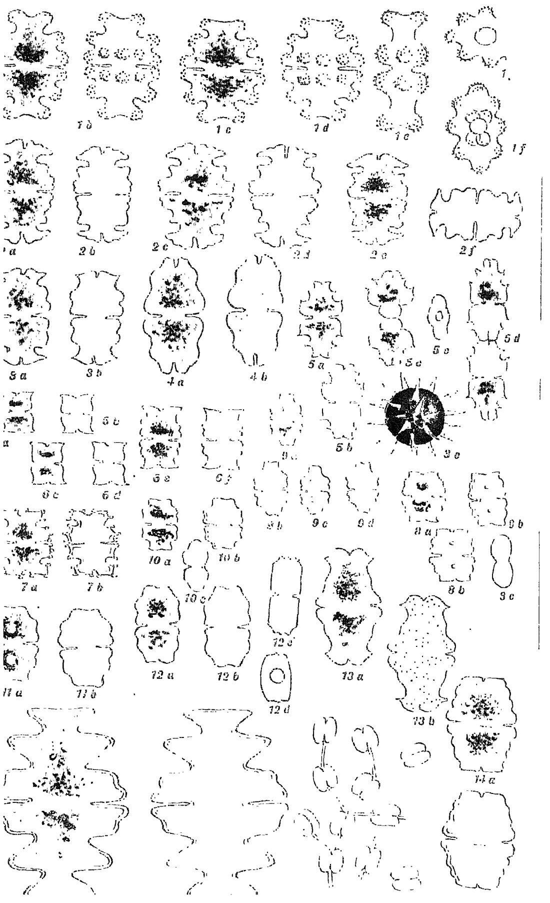
PL. 35.



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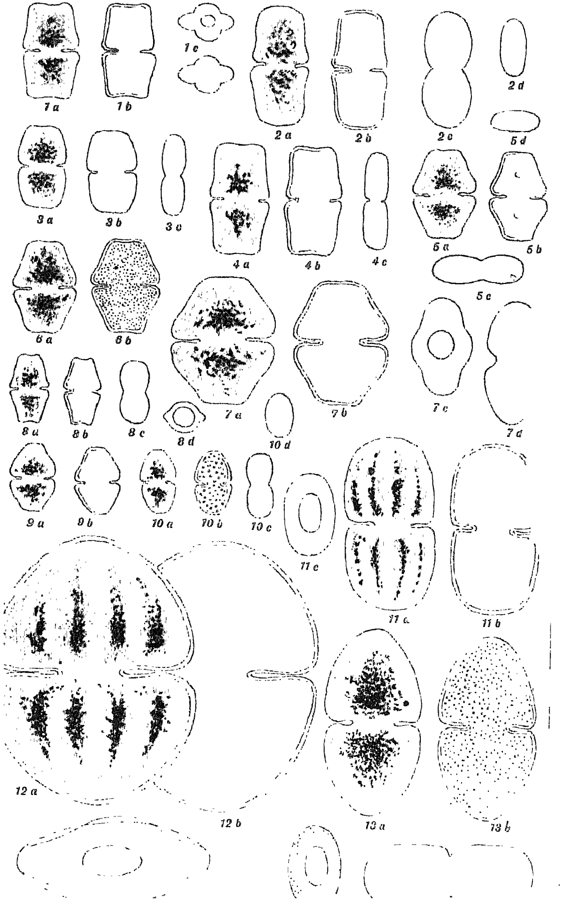
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4 c
5 a
5 b
5 c
6 a
6 b
7 a
7 b
7 c
7 d
8 a
8 b
8 c
8 d
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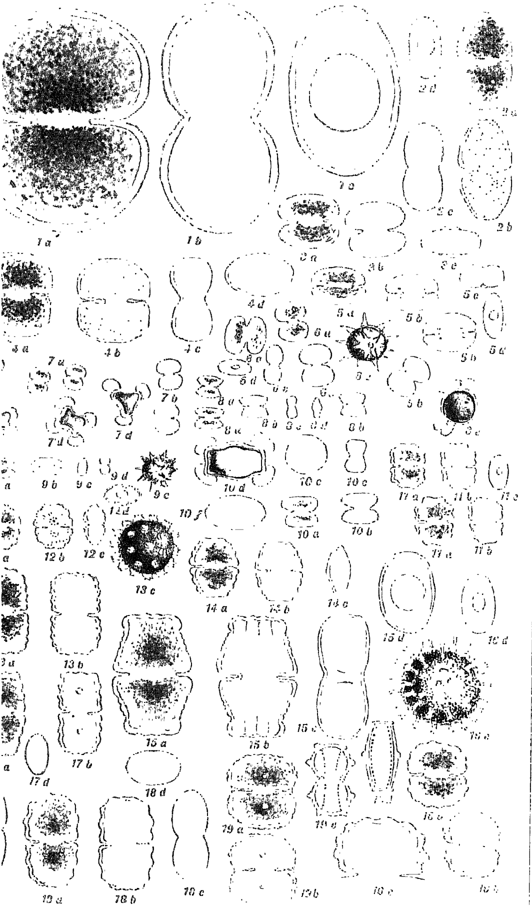
9 b
10 a
10 b
10 c
11 c
11 a
11 b
12 a
12 b
13 a
13 b

PL. 39.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1 b
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2 c
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2 e
3 a
3 b
3 c
4 a
4 b
4 c
4 d
5 a
5 b
5 c
5 d
6 a
7 a
7 b
7 d
8 a
8 b
8 c
8 d
9 b
9 c
9 d
10 a
10 b
10 c
10 d
10 f
11 a
11 b
11 c
12 b
12 c
12 d
13 b
13 c
14 a
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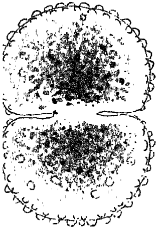
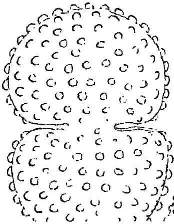
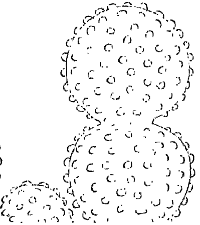
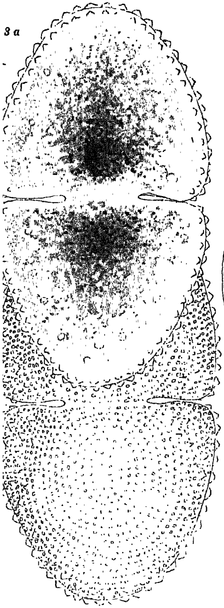
18 d
19 a
19 b
19 c



1 a

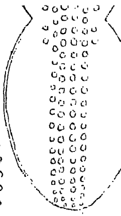




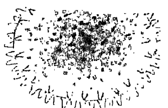


3 a

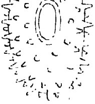
3 b



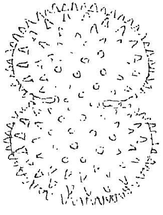
3 c



2 a

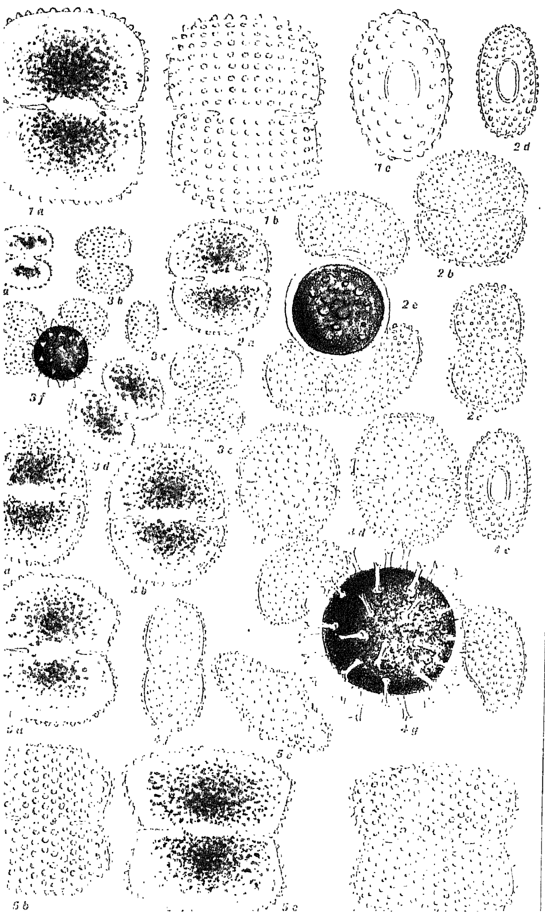


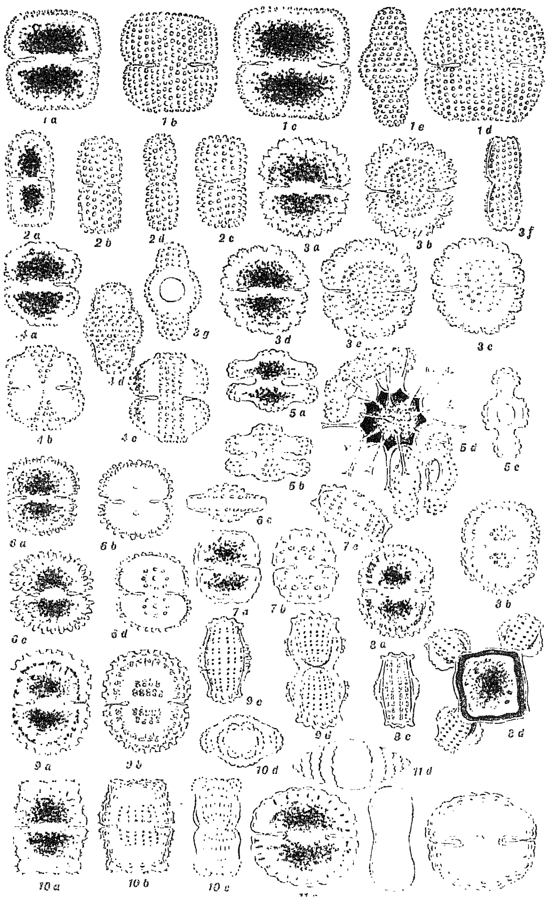
2 d



2 b

PL. 39.




1 a
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3 a
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3 f
4 a
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3 c
4 d
4 b
4 c
5 a
5 d
5 c
5 b
6 a
6 b
6 e
7 c
8 b
6 c
6 d
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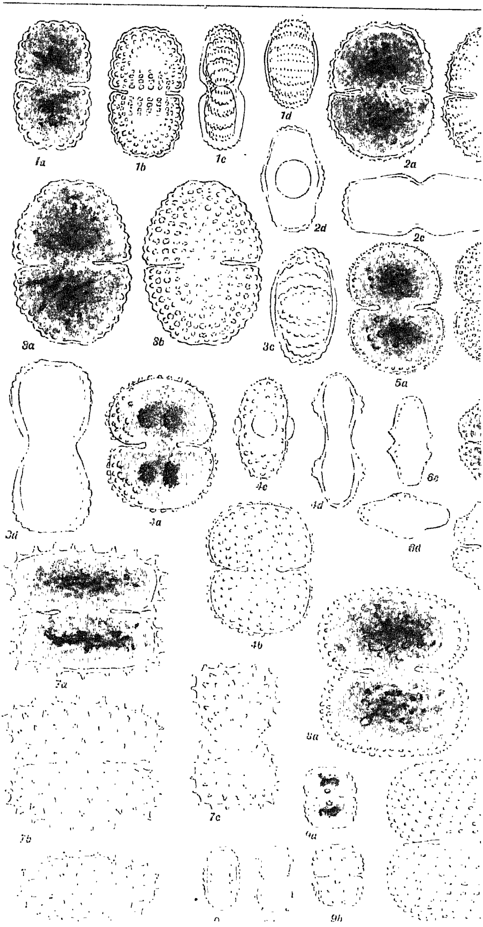
7 b
8 a
9 c
9 d
8 c
8 d
9 a
9 b
10 d
11 d
10 a
10 b
10 c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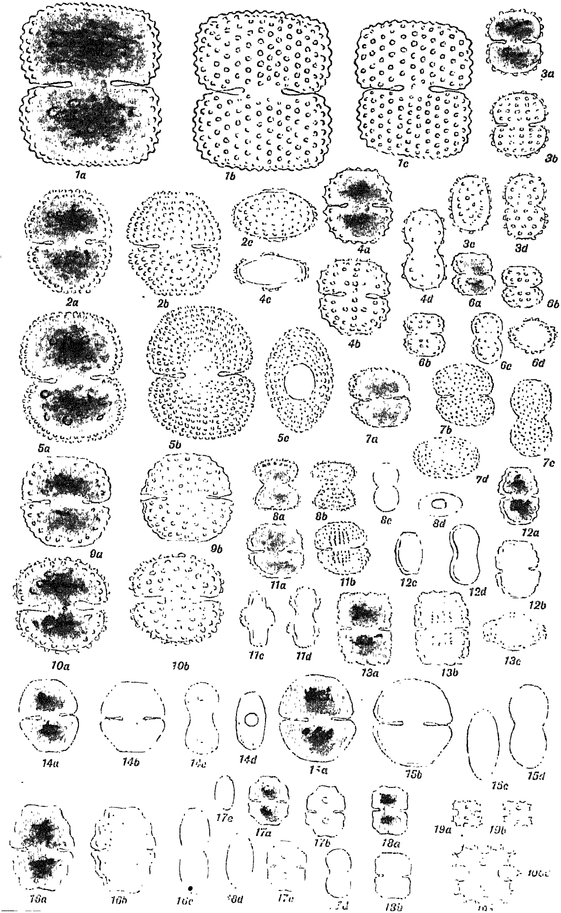
6d
4b
7a
8a
7b
7c
9a
9b

PL. 4



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3c
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17e
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16c
16d
17c
17d
18b
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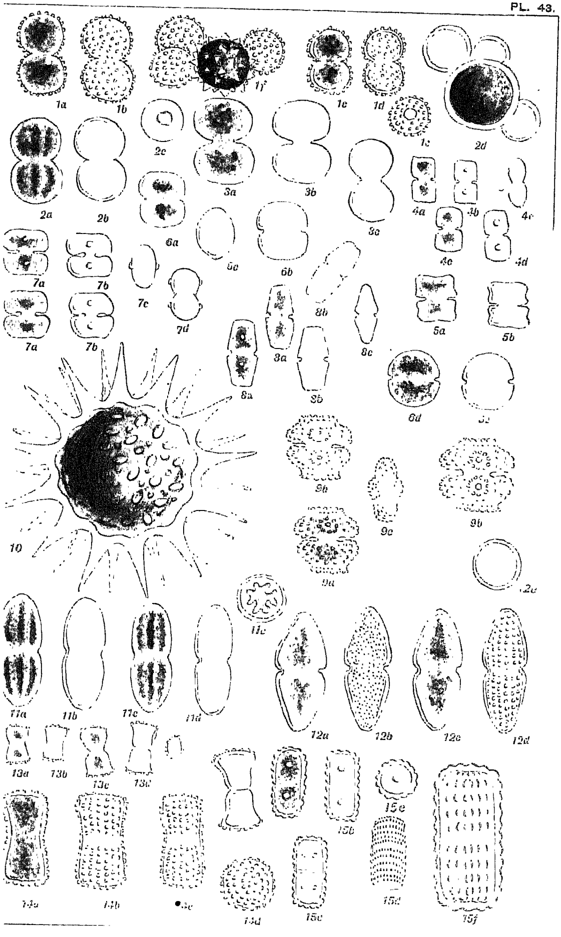
19d

PL. 43.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9a
12e
11e
11a
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15d
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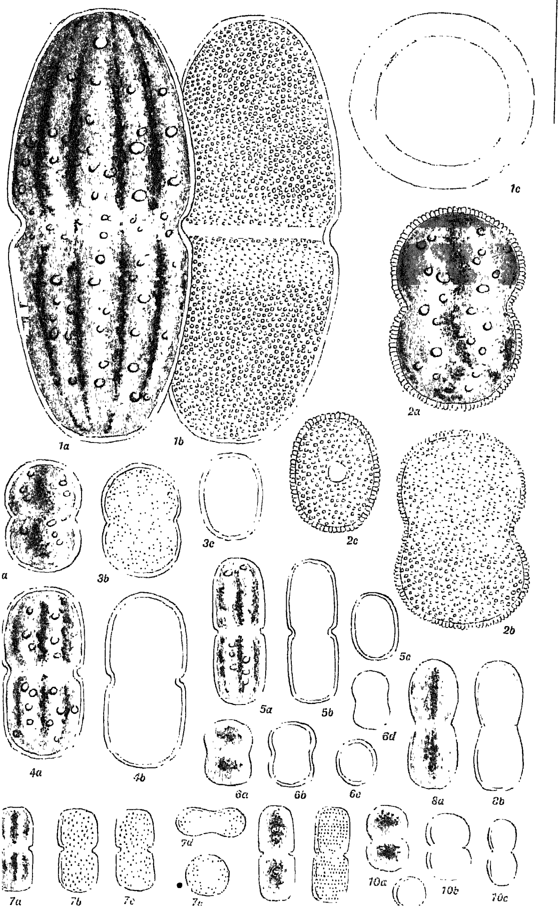
PL. 44.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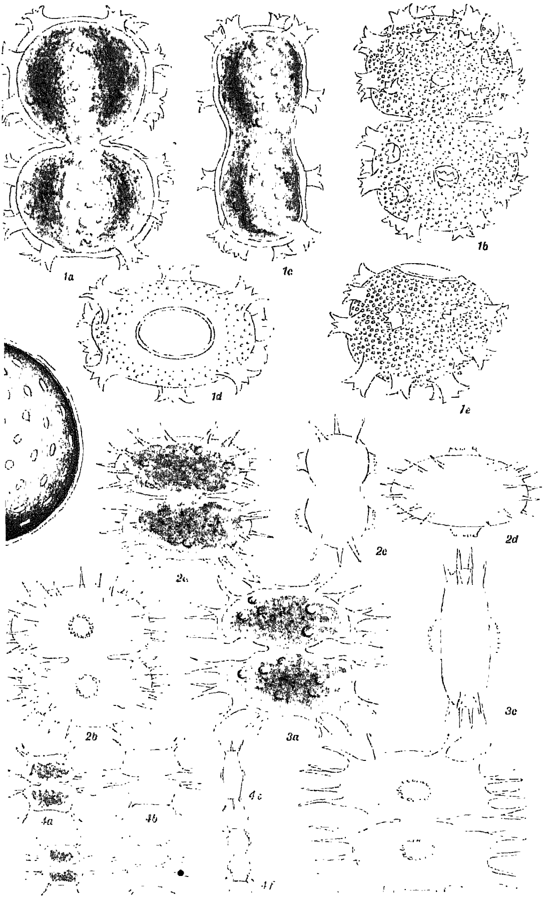
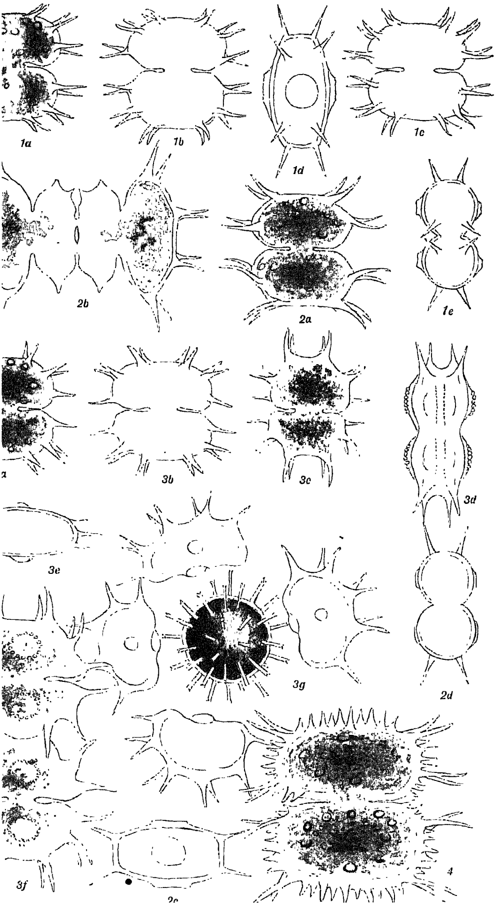
6d
8a
8b
7a
7b
7c
7d
7e
10a
10b
10c

PL. 45.

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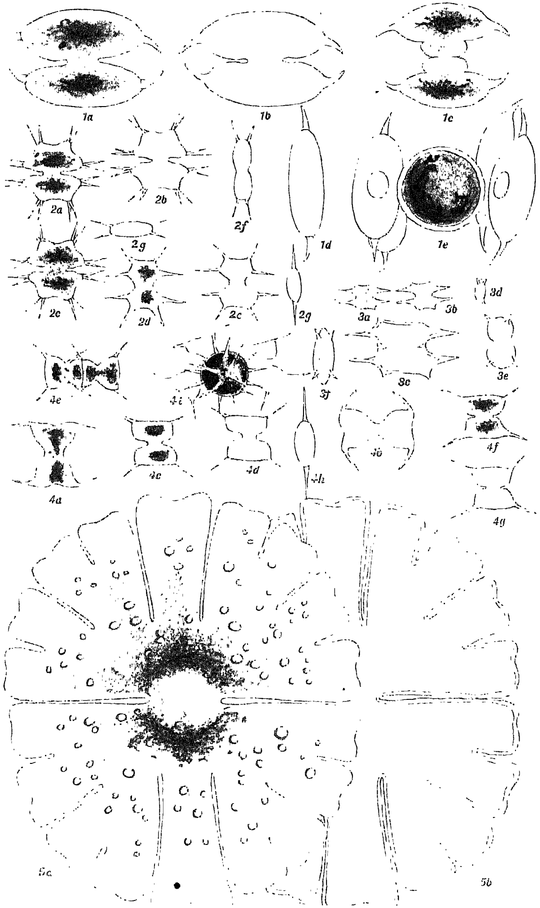
3f
2c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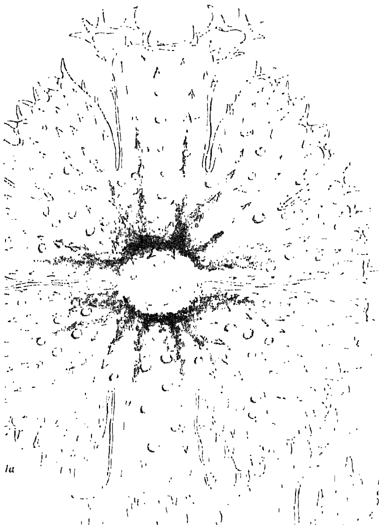
5b



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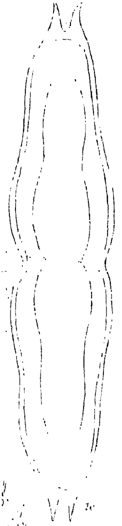
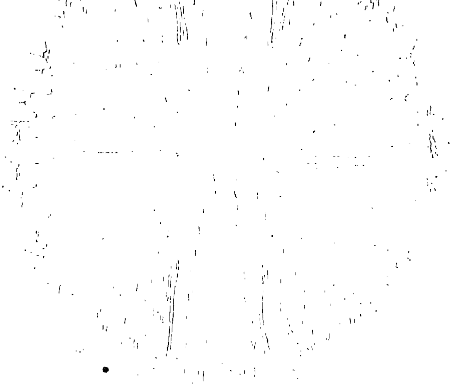
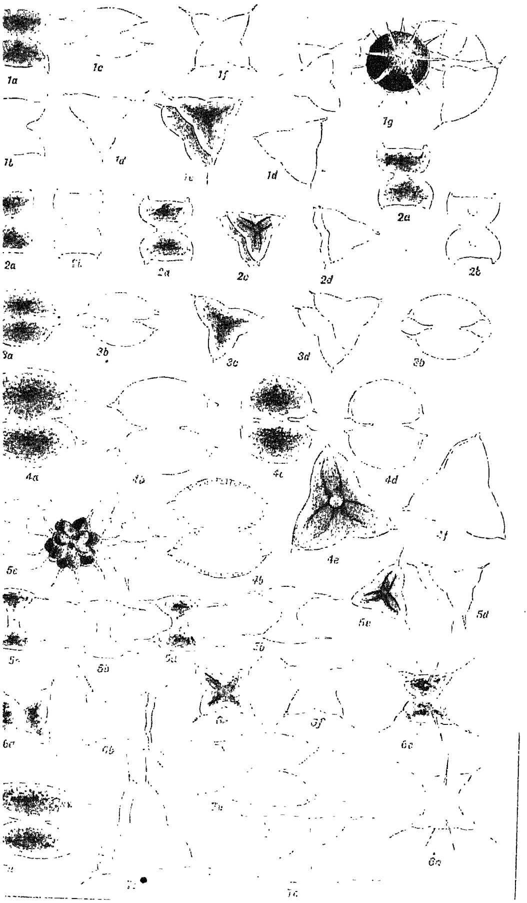


1c



PL. 49.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4f
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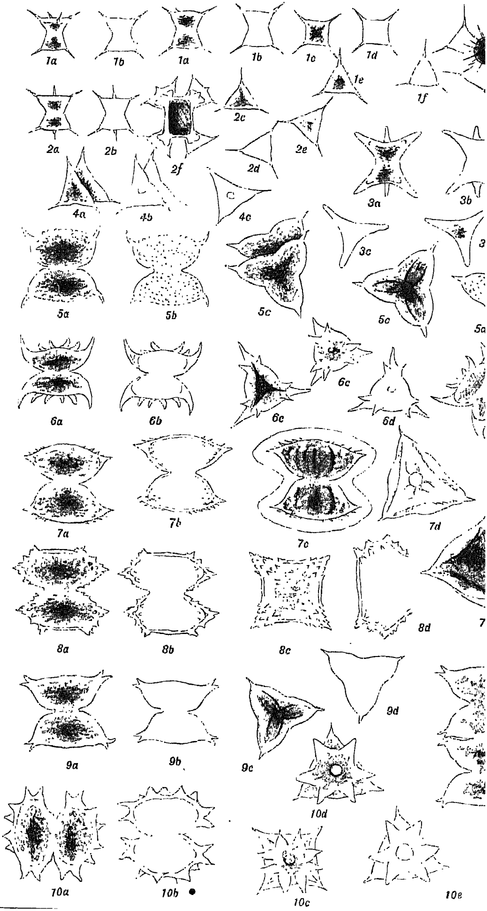
7c
6a



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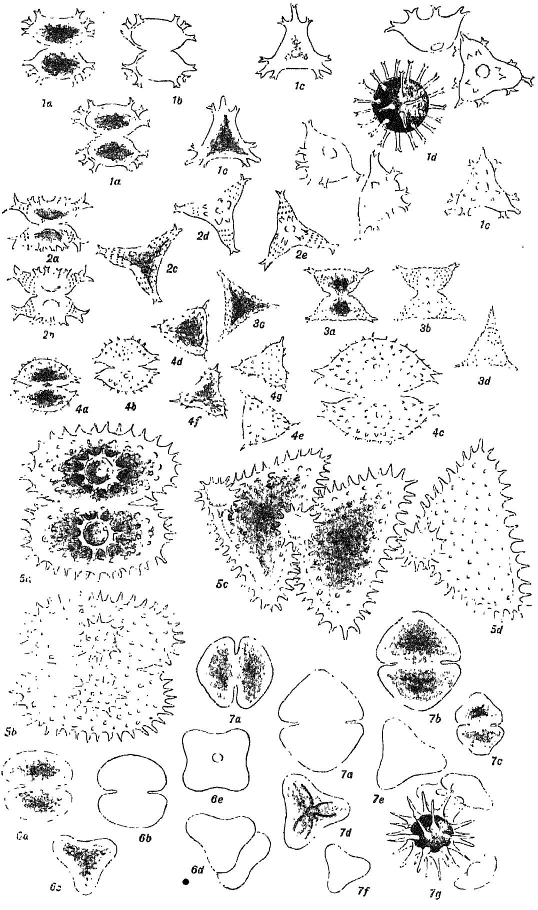
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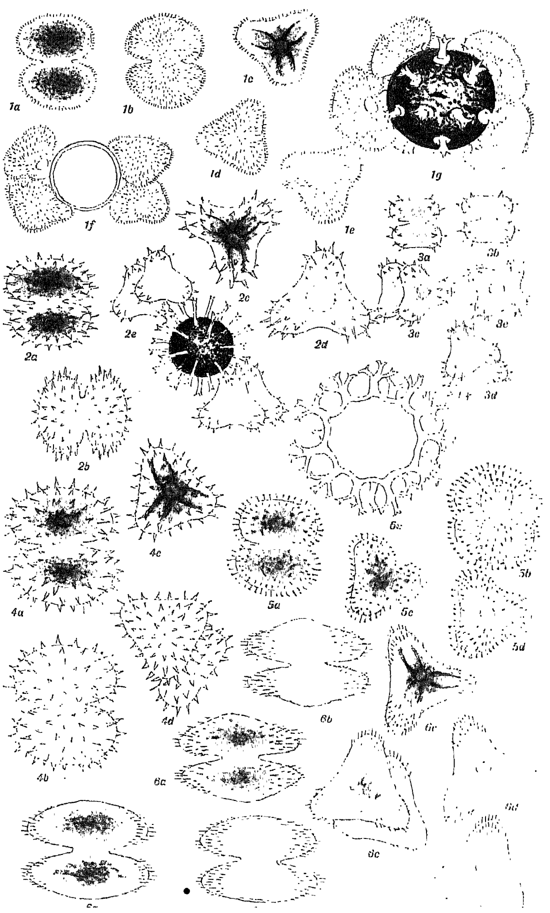
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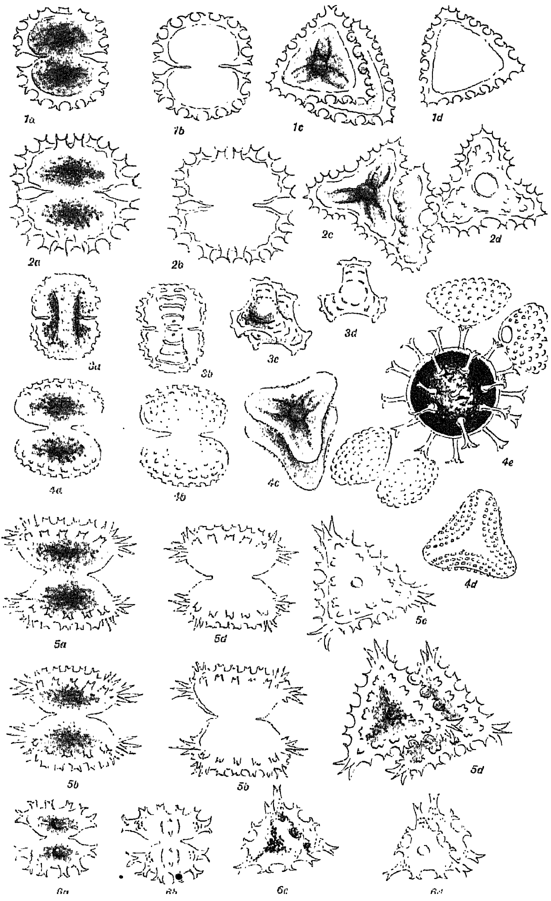
6c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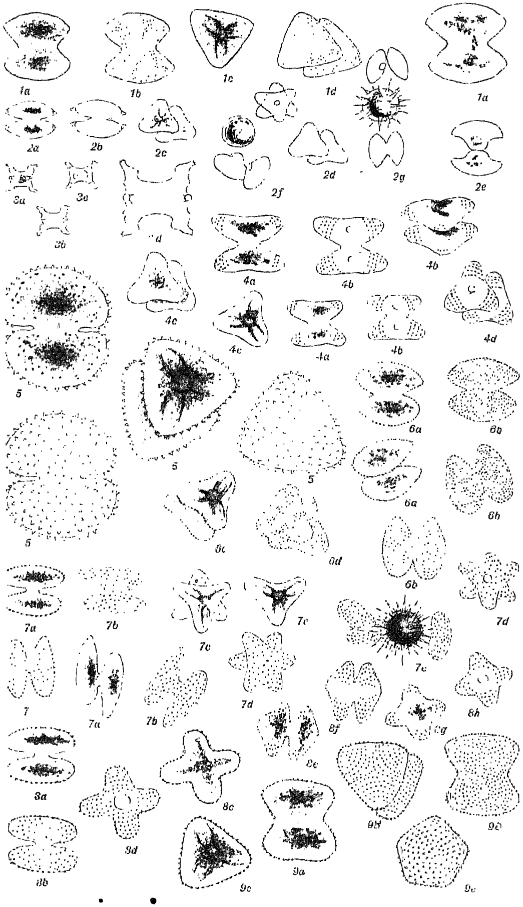

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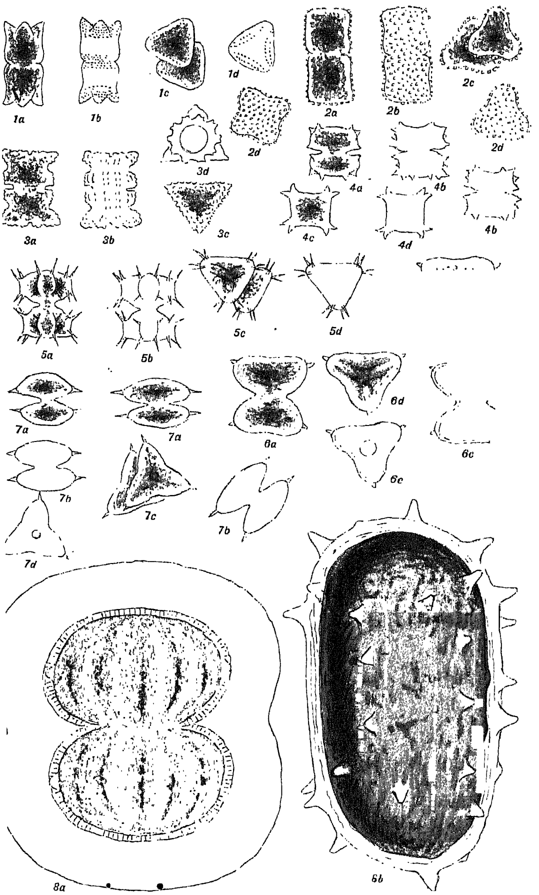
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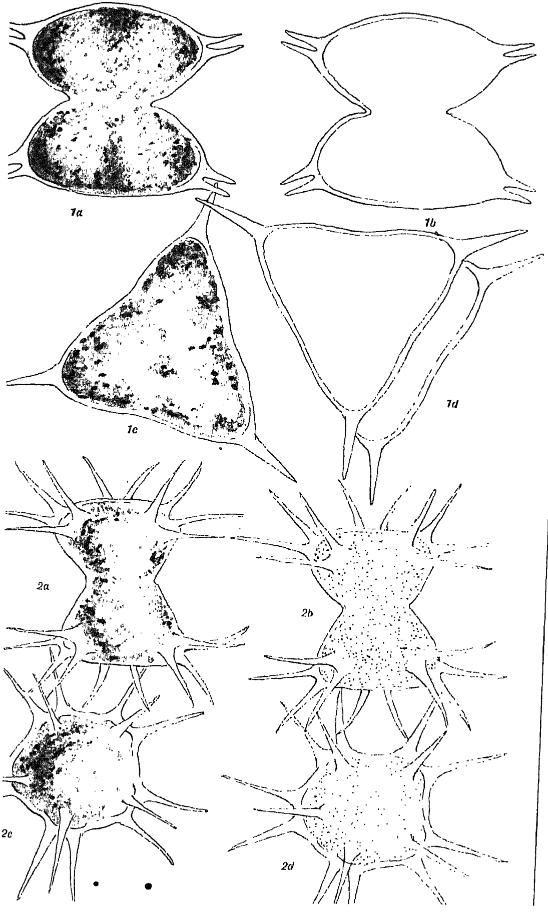
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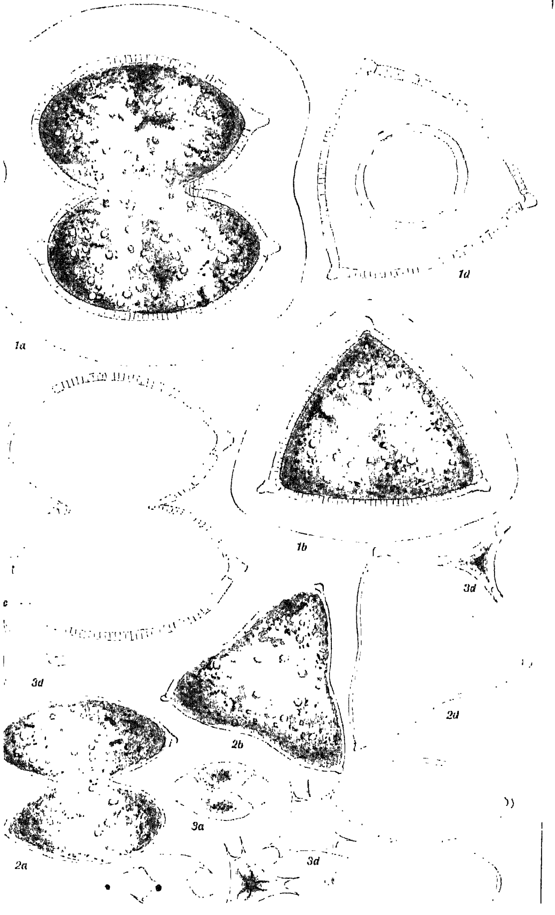
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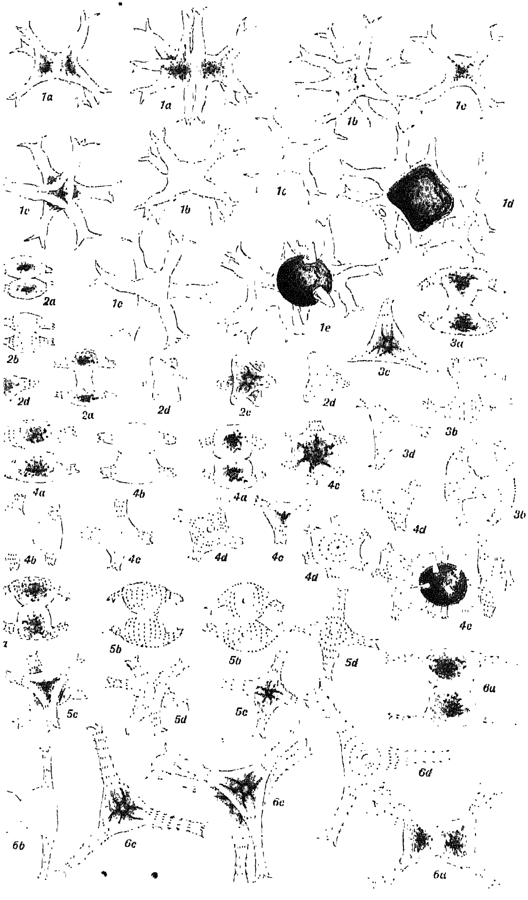
3d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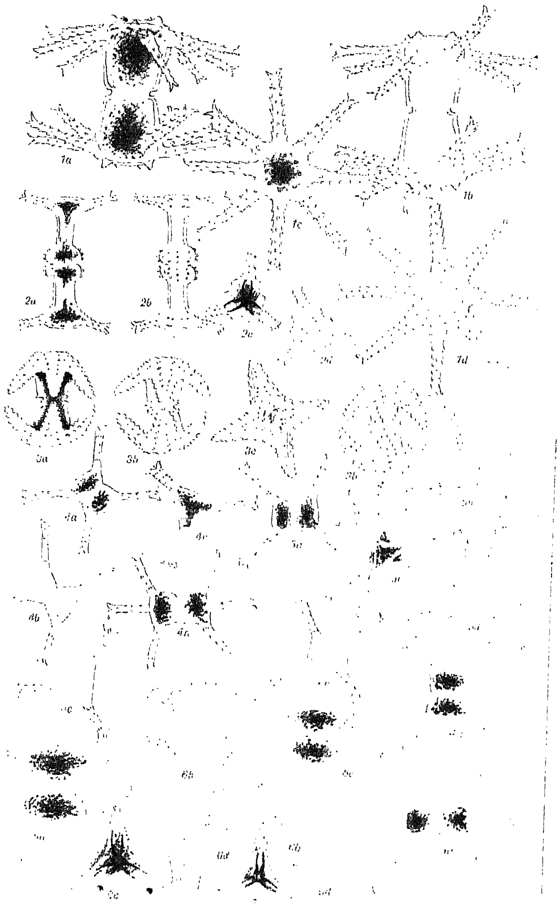
6a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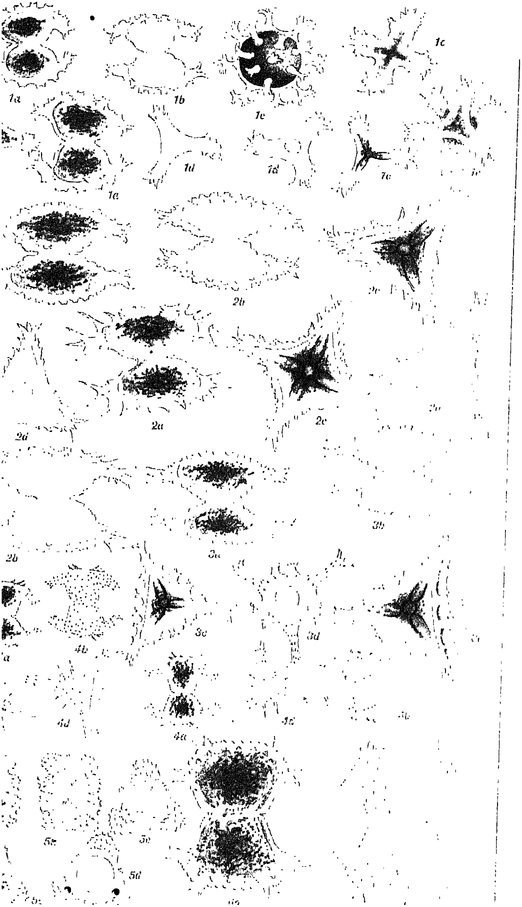
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4e
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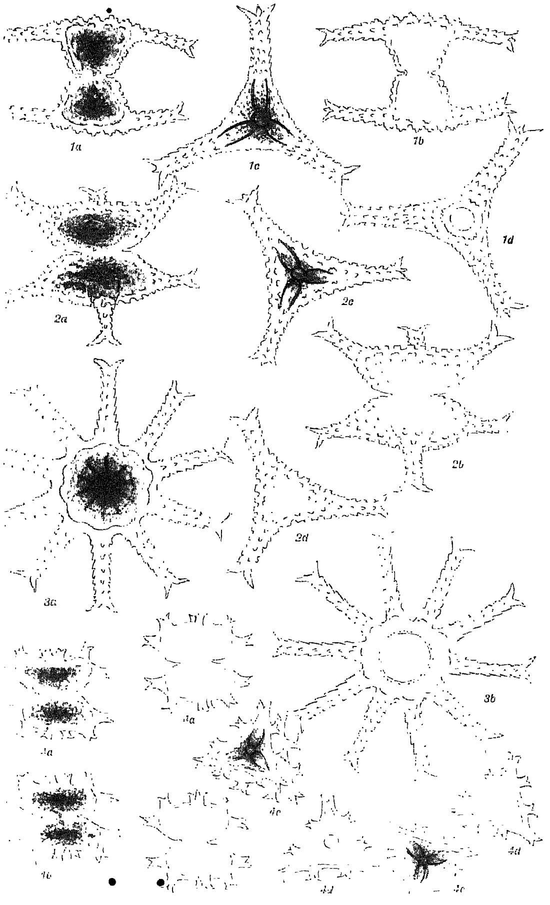
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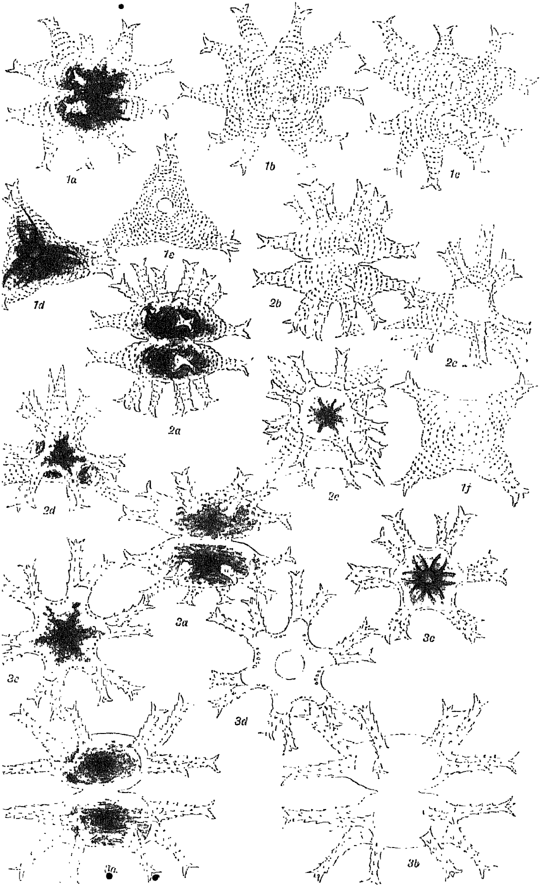
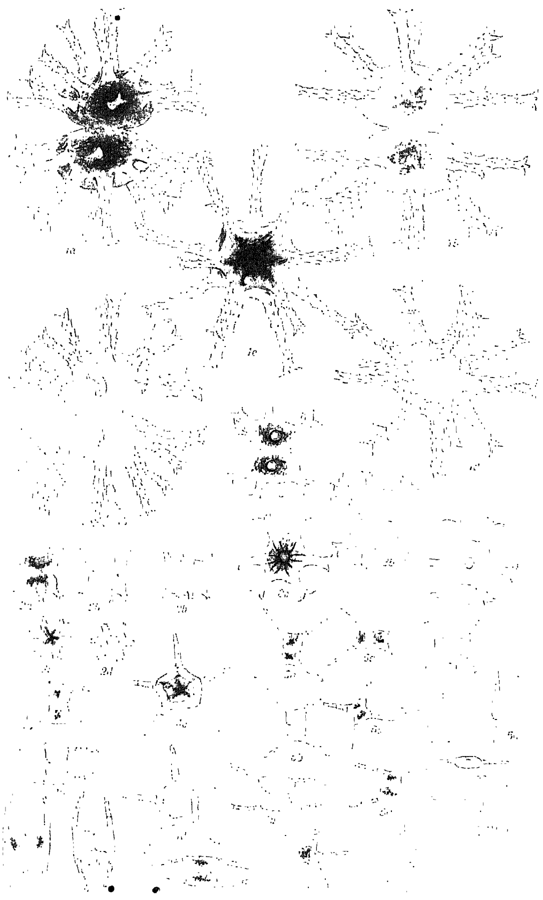
PL. 63.

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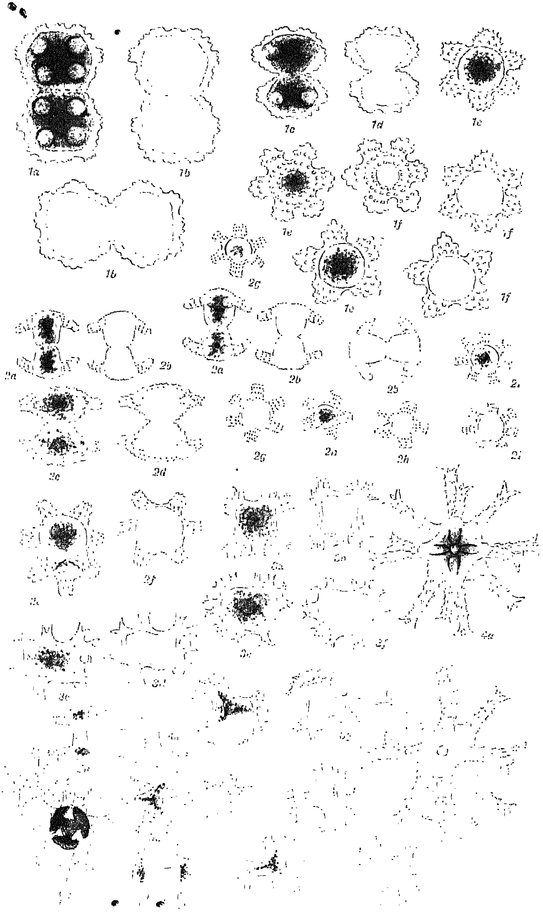
PL. 6


1a
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2i
2f
2a
2a
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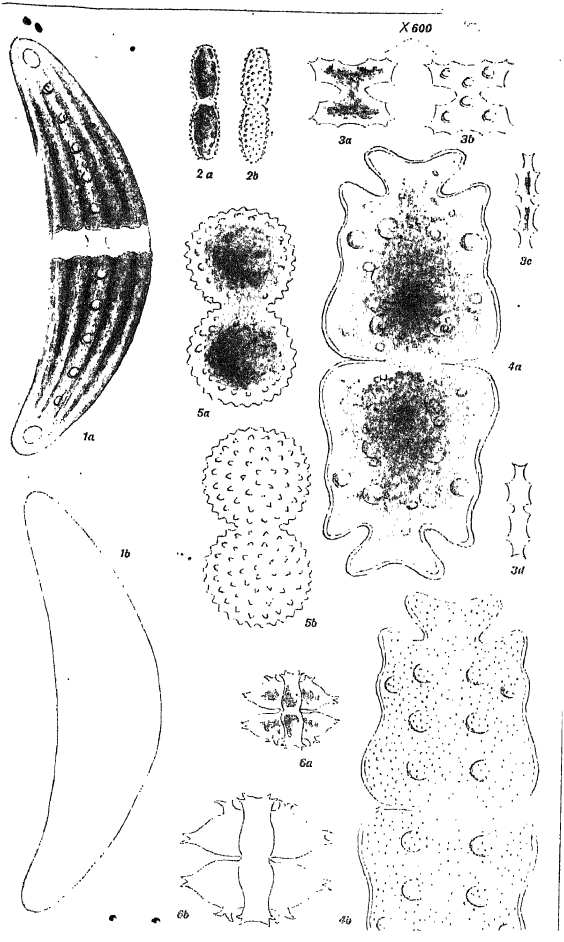
3e
3f
3d
3c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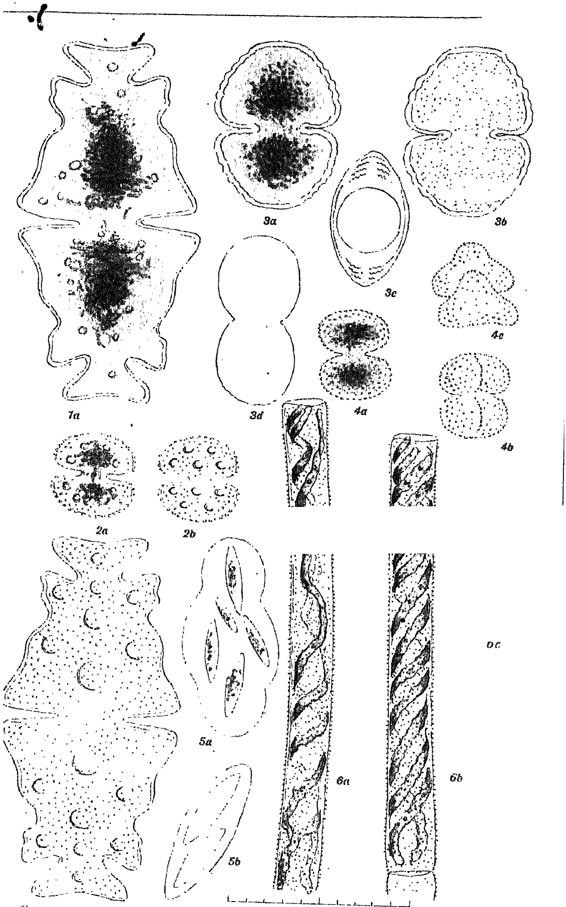
6b



Scale $\frac{1}{10}$th of a Millimetre = 100 M